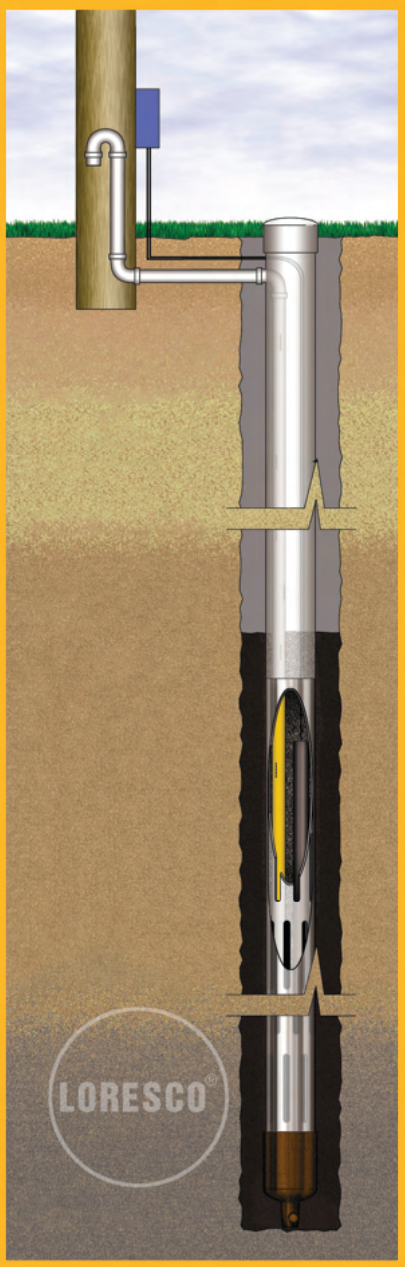
LORESCO®

The World's Leader in Impressed Current Anode Backfill



IMPRESSED CURRENT BACKFILLS

REPLACEABLE DEEP ANODE SYSTEMS

Standard Designs
Environmentally Sound Design

VENT SYSTEMS & SEALING PRODUCTS

ELECTRICAL GROUNDING BACKFILLS

REFERENCE DATA

Installation Data
Mechanical Data
Electrical Data

LORESCO®

Specializes in Quality, Service and Price

CLICK FOR TABLE OF CONTENTS

Table of Contents

LORESCO®

LORESCO® DELIVERS...WORLDWIDE!

With our trained staff of professionals, Loresco can ensure delivery of your order **on time** and **without damage** whether the shipment is *around the corner or around the world!*

Our **Standard Stretch-Wrapped Pallet** is the fastest, most economical packaging for shipments within the United States and Canada. For more rugged demands of overseas shipment, we recommend our **Ocean Pallet Box**. This packaging standard combines low cost with proven resistance to shipping damage. The ocean pallet box is a padded, moisture-resistant container suitable for limited outside storage.

We at Loresco pride ourselves in meeting the individual needs of our customers. With this thought in mind, we offer a number of alternate packaging arrangements including shipment in **Bulk Bags**.

Please contact us if you have special requirements.

QUALITY • SERVICE • PRICE

Impressed Current Backfills

RS•3®

SC•3®

SC•2®

DW•1®

SWK®

SW®

SWS™

EnviroCoke IV™

Earth Contact Backfill

Loresco RS•3 is the newest and most innovative super conducting earth contact backfill in the Loresco product line. RS•3 combines the characteristics of superior low resistivity and high bulk density with a remarkably rapid sinking ability to provide the latest in conductive carbon backfill technology. Because of the new rapid sinking ability RS•3 is able to achieve maximum compaction quickly. Rapid sinking allows for a faster construction completion time and faster energizing of the anode system. Rapid sinking allows for pouring when pumping is not an option. RS•3 is able to handle the demands of stringent field requirements. This is the first time a conductive carbon backfill combining pumping ability and pouring ability has been available in one bag. RS•3 is manufactured under a new process which creates a new surface with superior conductive properties. This manufacturing process is exclusive to conductive carbon formulations designed for cathodic protection. The new manufacturing process ensures the impressed current anode and RS•3 system have increased electronic flow performance to further increase the life of the anode system. Loresco RS•3 is produced specifically for cathodic protection applications using an exclusive multi-step process.

First, a very high quality base carbon with desired characteristics is selected. **Next**, this carbon is calcined to a minimum temperature of 1250° C under very exacting and controlled standards. This step results in semi-graphitized carbon particles with excellent conductivity. All particles shaped and surface modified for maximum electrical conductivity and high-current applications. **Then**, to further improve the bulk conductivity, the surfaces of the individual particles are *modified* to enhance the contact conductance in a process exclusive only to the corrosion industry. This breakthrough in surface alteration ensures maximum electronic current transfer with positive anode contact. **Finally**, a specially formulated surfactant is added to reduce particle surface tension for compact settling under water.

Loresco RS•3 has a bulk density of 68 lbs per cubic foot. The fixed carbon content is greater than 99% by weight. The bulk density and high fixed carbon content coupled with the assured low resistivity medium allows for longer groundbed life at a lower operating cost.

INSTALLATION

Loresco RS•3, due to its maufacturing process, is simple to install by either mixing and pumping or by pouring dry. With deep anode systems, pumping from the bottom up is recommended. Loresco RS•3 has superb pumping qualities due to the addition of surfactants and when agitated in water, takes on the characteristics of super heavy mud. Time before energizing is greatly reduced after installing RS•3. The modified surface of the carbon particles coupled with the action

Earth Contact Backfill

of the surfactants in RS•3 will achieve positive electrical contact by settling. Vibrating or compacting is not necessary. See installation section on page 34 in this catalog for additional pumping data.

Certified to NSF/ANSI/CAN/60

RS•3 WORKS

Loresco RS•3 represents technology developed exclusively for high current cathodic protection installations. RS•3 will satisfy all functioning requirements for a premium earth contact backfill.

Specify Loresco RS•3. It works.

DRY VOLUME OF LORESCO TYPE RS3 REQUIRED VS. CYLINDRICAL HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	LBS. TYPE RS3 PER FT.	FT. TYPE RS3 PER 100 LBS.	LBS. RS3 PER 100 FT. OF HOLE
4"	.087	5.9	16.90	590
6"	.196	13.3	7.50	1330
8"	.349	23.7	4.21	2370
10"	.545	37.1	2.70	3710
12"	.784	53.3	1.88	5330

Visit us online @ www.loresco.com

use our convenient online calculators

MATERIAL DESCRIPTION

Loresco RS•3 is a surface modified, blended, and sized carbon backfill with surfactants.

SPECIFICATIONS

Fixed Carbon	99.4%
Ash	0.5%
Moisture	0.1%
Volatiles	nil (950°C)*
Bulk Density	68 lbs. per cubic foot

- All particles shaped and surface modified for maximum electrical conductivity and high-current applications
- Particle sized to facilitate pumping and pouring applications with rapid settling
- Maximum particle size 2.5mm
- Minimum calcination temperature of base materials is 1250° C
- Base materials are calcined under ISO 9002:2000 quality control
- No de-dusting oils are used during the manufacture of base particles

Typical values shown above. Specifications subject to changes without notice.

**Hydrogen / hydrocarbons nil due to calcination temperature in excess of 1200° C*

Earth Contact Backfill

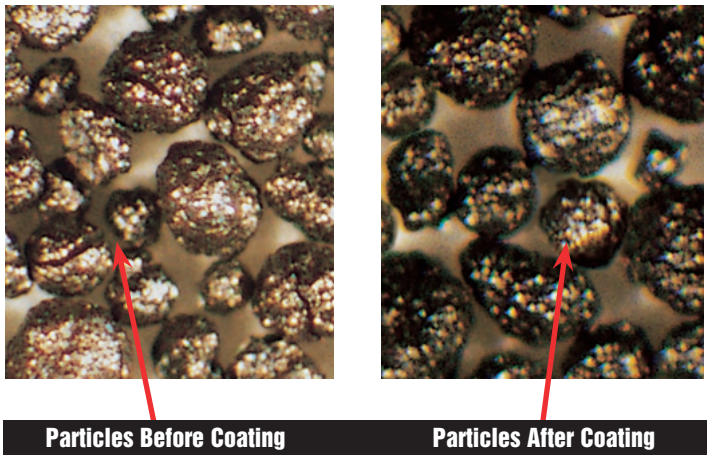
Loresco SC•3 is the *finest* earth contact backfill in the Loresco line of products. Loresco is already acknowledged around the world as a leader in cathodic protection. A dramatic breakthrough in over thirty years of research has now produced a super-conducting premium earth contact backfill called Loresco SC•3. Once again, Loresco defines the standard for quality and performance in the cathodic protection industry.

Loresco SC•3 is designed specifically for demanding anode systems which mandate a low resistivity medium. SC•3 is a dust free product and, according to EPA extraction tests, is extremely pure and complies with regulations governing buried products. Utilizing a modified industrial standard method for testing permeability (API RP-27), SC•3 will mitigate fluid interchange between aquifers. Loresco SC•3 is produced specifically for cathodic protection applications using an exclusive multi-step process.

First, a very high quality base carbon with desired characteristics is selected. **Next**, this carbon is calcined to a minimum temperature of 1250° C under very exacting and controlled standards. This step results in semi-graphitized carbon particles with excellent conductivity. **Then**, to further improve the bulk conductivity, the surfaces of the individual particles are *modified* to enhance the contact conductance. This breakthrough in surface alteration ensures maximum electronic current transfer with positive anode contact. **Finally**, a specially formulated surfactant is added to reduce particle surface tension for compact settling under water.

Loresco SC•3 has a bulk density of 74 lbs per cubic foot. The fixed carbon content is greater than 99% by weight. The bulk density and high fixed carbon content coupled with the assured low resistivity medium allows for longer groundbed life at a lower operating cost.

The photo below is a magnification of Loresco SC•3



INSTALLATION

Loresco SC•3, due to its dust-free manufacture, is simple to install by either mixing and pumping or by pouring dry. With deep anode systems, pumping from the bottom up is recommended. Loresco SC•3 has superb pumping qualities due to the addition of surfactants and when agitated in water, takes on the characteristics of heavy

mud. A recommended mix is seven gallons of water per one-hundred pounds. After installing SC•3, allow twenty-four hours settling time before energizing. The modified surface of the carbon particles coupled with the action of the surfactants in SC•3 will achieve positive electrical contact by settling. Vibrating or compacting is not necessary. See installation section in this catalog for additional pumping data.

Certified to NSF/ANSI/CAN/60

SC•3 WORKS

Loresco SC•3 represents technology developed exclusively for high current cathodic protection installations. SC•3 will satisfy all functioning requirements for a premium earth contact backfill.

Specify Loresco SC•3. It works.

DRY VOLUME OF LORESCO TYPE SC3 REQUIRED VS. CYLINDRICAL HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	LBS. TYPE SC3 PER FT.	FT. TYPE SC3 PER 100 LBS.	LBS. SC3 PER 100 FT. OF HOLE
4"	.087	6.4	15.70	640
6"	.196	14.3	6.99	1430
8"	.349	25.5	3.93	2550
10"	.545	39.8	2.51	3980
12"	.784	57.2	1.75	5720

Visit us online @ www.loresco.com

use our convenient online calculators

MATERIAL DESCRIPTION

Loresco SC•3 is a surface modified, blended, and sized carbon backfill with surfactants.

SPECIFICATIONS

Fixed Carbon	99.35%
Ash	0.6%
Moisture	0.05%
Volatiles	nil (950°C)*
Bulk Density	74 lbs. per cubic foot

- Predominantly round particles
- All particles surface modified for maximum electrical conductivity and high current applications
- Particle sizing to be dust free with a maximum particle size of 1mm
- Minimum calcination temperature of base materials is 1250° C
- Base materials are calcined under ISO 9002:2000 quality control
- Surfactants are added to assist pumping and settling
- No de-dusting oils are used during the manufacture of base particles

Typical values shown above. Specifications subject to changes without notice.

**Hydrogen / hydrocarbons nil due to calcination temperature in excess of 1200° C*

Earth Contact Backfill

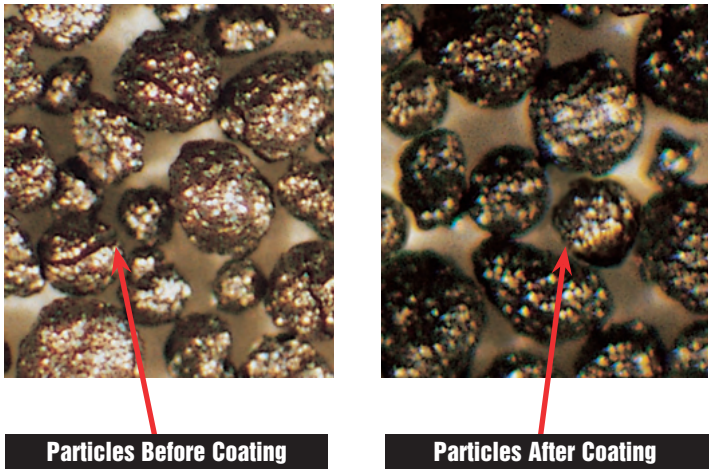
Loresco SC•2 is one of Loresco's *premium* earth contact backfills manufactured for deep anode systems. Loresco is already acknowledged around the world as a leader in cathodic protection. A dramatic breakthrough in over thirty years of research has now produced a super conducting premium earth contact backfill called Loresco SC•2. Once again, Loresco defines the standard for quality and performance in the cathodic protection industry.

Loresco SC•2 is designed specifically for deep anode systems. Loresco SC•2 is a dust free product and, according to EPA extraction tests, is extremely pure and complies with regulations governing buried products. SC•2 mixes easily with water and may be pumped into deep anode systems. Loresco SC•2 is designed to promote electronic flow between the anode surface and itself. Loresco SC•2 is produced especially for cathodic protection applications using an exclusive multi-step process.

First, a very high quality base carbon with desired characteristics is selected. **Next**, this carbon is calcined to a minimum temperature of 1250° C under very exacting and controlled standards. This step results in semi-graphitized carbon particles with excellent conductivity. **Then**, to further improve the bulk conductivity, the surfaces of the individual particles are *partially-modified* to enhance the contact conductance. This breakthrough in surface alteration ensures maximum electronic current transfer with positive anode contact. The surface alteration on the particle surfaces is not easily removed and stands up to the vigorous application methods in all field requirements.

Loresco SC•2 has a bulk density of 74 lbs per cubic foot. The fixed carbon content is greater than 99% by weight. The bulk density and high fixed carbon content coupled with the assured low resistivity medium allows for longer groundbed life at a lower operating cost.

The photo below is a magnification of Loresco SC•2



INSTALLATION

Loresco SC•2 has excellent pumping qualities and when agitated in water, takes on the characteristics of heavy mud. A recommended mix is seven gallons of water per one-hundred pounds. After installing

Earth Contact Backfill

SC•2, allow twenty-four hours settling time before energizing. The *partially modified* surface of the carbon particles in SC•2 will achieve positive electrical contact by settling. Vibrating or compacting is not necessary. See installation section of this catalog for additional pumping data.

SC•2 WORKS

Loresco SC•2 represents technology developed exclusively for deep and shallow impressed current cathodic protection installations. SC•2 is a premium earth contact backfill.

Specify Loresco SC•2. It works.

DRY VOLUME OF LORESCO TYPE SC2 REQUIRED VS. CYLINDRICAL HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	LBS. TYPE SC2 PER FT.	FT. TYPE SC2 PER 100 LBS.	LBS. SC2 PER 100 FT. OF HOLE
4"	.087	6.4	15.70	640
6"	.196	14.3	6.99	1430
8"	.349	25.5	3.93	2550
10"	.545	39.8	2.51	3980
12"	.784	57.2	1.75	5720

Visit us online @ www.loresco.com

use our convenient online calculators

MATERIAL DESCRIPTION

Loresco SC•2 is a partially surface modified, blended, and sized carbon backfill.

SPECIFICATIONS

Fixed Carbon	99.35%
Ash	0.6%
Moisture	0.05%
Volatiles	nil (950°C)*
Bulk Density	74 lbs. per cubic foot

- Predominantly round particles
- Particles surface modified for increased electrical conductivity
- Particle sizing to be dust free with a maximum particle size of 1mm.
- Minimum calcination temperature of base materials is 1250° C
- Base materials are calcined under ISO 9002:2000 quality control
- No de-dusting oils are used during the manufacture of base particles

Typical values shown above. Specifications subject to changes without notice.

**Hydrogen / hydrocarbons nil due to calcination temperature in excess of 1200° C*

DW•1 EARTH CONTACT BACKFILL

Loresco DW•1 is a sized carbon backfill with particles ranging between .004 inch to 1 mm. DW•1 weighs seventy-four pounds per cubic foot and sinks readily in water or light mud. The fixed carbon content of DW•1 is over ninety-nine percent.

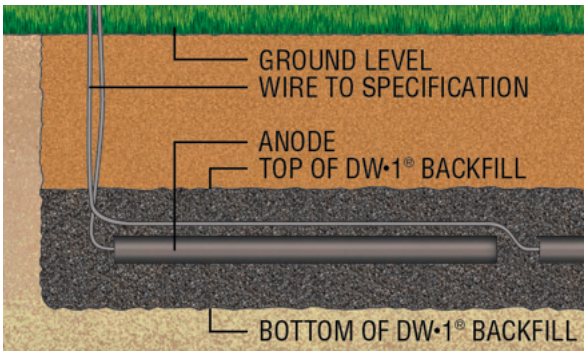
Being a sized and predominantly round material, DW•1 may be installed by either pumping or pouring. Approximately seven gallons of water per one-hundred pounds of backfill should be utilized when pumping. DW•1 wets easily and only minimum agitation is necessary before pumping.

DW•1 is a product specifically manufactured to be placed into the earth. According to EPA-approved leacherate tests, DW•1 meets all purity requirements for materials utilized in underground burial. There are no "dedusting oils" allowed in the manufacture of Loresco DW•1.

INSTALLATION

Loresco DW•1 may be poured freely into dry applications. Tamping is not required. When it is applied by pumping, the recommended method is to pump from the bottom of the bored hole upward.

After the application pipe (a one-inch steel pipe) has been lowered down to the bottom of the bored hole, it is coupled to a 20 GPM pump with a minimum capacity of 250 psi. Normally, the application pipe does not have to be raised during pumping procedures. Refer to installation section in this catalog for additional pumping information.



Typical Horizontal Installation

HORIZONTAL INSTALLATION PROCEDURE

(see illustration)

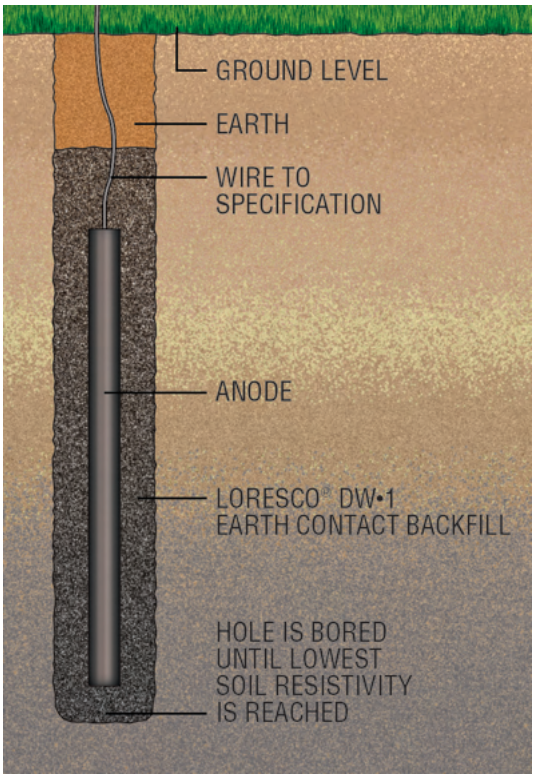
- Have a reasonably clean ditch (design usually calls for a ditch one foot wide.)
- Pour Loresco DW•1 in a continuous layer six inches deep (or as specified.)
- Place anodes on top of DW•1.
- Pour DW•1 in a continuous layer six inches deep until anodes are covered by a six inch backfill cover (or as specified.)
- Fill the remainder of the ditch as specified.
- Fill remainder of hole as design specifies.

Earth Contact Backfill

VERTICAL INSTALLATION PROCEDURE

(see illustration)

- Have a reasonably clean hole (depth depending on soil resistivity.)
- Place one foot of DW•1 in bottom of hole.
- Lower and center anode in proper position.
- Pour DW•1 over anode until design level is reached.
- Fill remainder of hole as design specifies.



Typical Vertical Installation

DRY VOLUME OF LORESCO TYPE DW-1 REQUIRED VS. CYLINDRICAL HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	LBS. TYPE DW-1 PER FT.	FT. TYPE DW-1 PER 100 LBS.	LBS. DW-1 PER 100 FT. OF HOLE
4"	.087	6.4	15.70	640
6"	.196	14.3	6.99	1430
8"	.349	25.5	3.93	2550
10"	.545	39.8	2.51	3980
12"	.784	57.2	1.75	5720

SPECIFICATIONS

Fixed Carbon	99.35%
Ash	0.6%
Moisture	0.05%
Volatiles	nil (950°C)*
Bulk Density	74 lbs. per cubic foot
Particle Sizing	Ranging from .004 inch to 1 mm.

Typical values shown above. Specifications subject to changes without notice.

**Hydrogen / hydrocarbons nil due to calcination temperature in excess of 1200° C*

Visit us online @ www.loresco.com

use our convenient online calculators

Earth Contact Backfill

SWK EARTH CONTACT BACKFILL

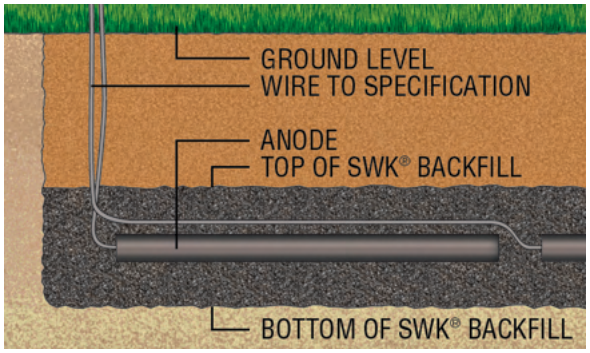
Loresco SWK is designed specifically for impressed current surface and containerized anodes. It has particle sizes ranging from .004 in. to one-half (1/2) in. SWK is heavy and sinks readily in water or light mud. It can be installed by pouring around the anodes and tamping is not necessary.

The particles of SWK exhibit a hard round shape and are composed of almost solid carbon. The bulk density of SWK is seventy pounds per cubic foot and the porosity is forty-four percent. SWK is a product designed specifically for use around anodes in the earth.

The low resistivity of SWK enables intimate anode contact and assures that most electrolytic discharge will occur at the backfill periphery. According to EPA-approved leacherate tests, SWK meets all purity requirements for materials utilized in underground burial. There are no "dedusting oils" allowed in the production of Loresco SWK.

INSTALLATION

Loresco SWK may be poured freely in dry applications. Tamping is not required. If SWK is poured through water or light mud, the rate of pouring should not exceed the rate of SWK's wetting and sinking. The rate of pouring through water will be approximately one-hundred pounds per two minutes.



Typical Horizontal Installation

HORIZONTAL INSTALLATION PROCEDURE

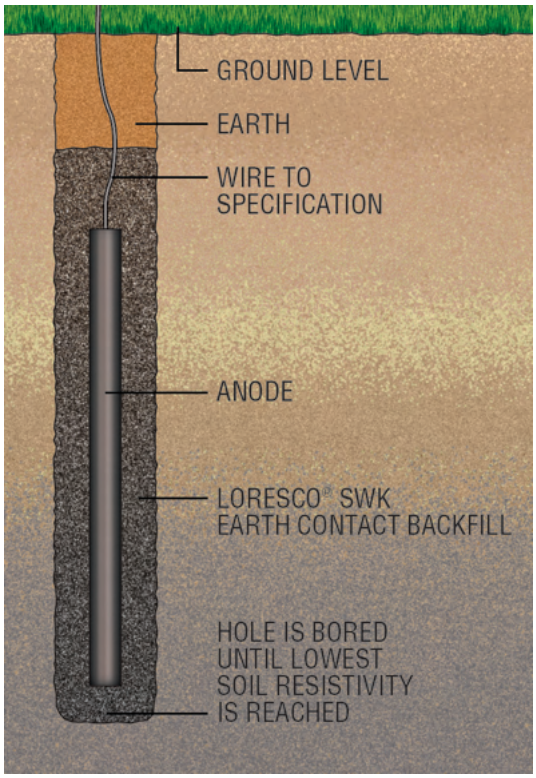
(see illustration)

- Have a reasonably clean ditch (design usually calls for a ditch one foot wide.)
- Pour Loresco SWK in a continuous layer six inches deep (or as specified.)
- Place anodes on top of SWK.
- Pour SWK in a continuous layer until anodes are covered by a six inch backfill cover or as specified.
- Fill the remainder of the ditch as specified.

Earth Contact Backfill

VERTICAL INSTALLATION PROCEDURE

- Have a reasonably clean hole (depth depending on soil resistivity.)
- Place one foot of SWK in bottom of hole.
- Lower and center anode in proper position.
- Pour SWK over anode until design level is reached.
- Fill remainder of hole as design specifies.



Typical Vertical Installation

DRY VOLUME OF LORESCO TYPE SWK REQUIRED VS. CYLINDRICAL HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	LBS. TYPE SWK PER FT.	FT. TYPE SWK PER 100 LBS.	LBS. SWK PER 100 FT. OF HOLE
4"	.087	6.1	16.40	610
6"	.196	13.7	7.30	1370
8"	.349	24.4	4.10	2440
10"	.545	38.2	2.62	3820
12"	.784	54.9	1.82	5490

SPECIFICATIONS

Fixed Carbon	99.35%
Ash	0.6%
Moisture	0.05%
Volatiles	nil (950°C)*
Bulk Density	70 lbs. per cubic foot
Particle Sizing	Ranging from .004 to 1/2 inch

Typical values shown above. Specifications subject to changes without notice.

**Hydrogen / hydrocarbons nil due to calcination temperature in excess of 1200° C*

Visit us online @ www.loresco.com

use our convenient online calculators

Earth Contact Backfill

SW EARTH CONTACT BACKFILL

Loresco SW is designed for use in impressed current surface systems. SW is also suitable for containerized anode systems and semi-deep impressed current systems. SW may be poured dry or through water or light mud.

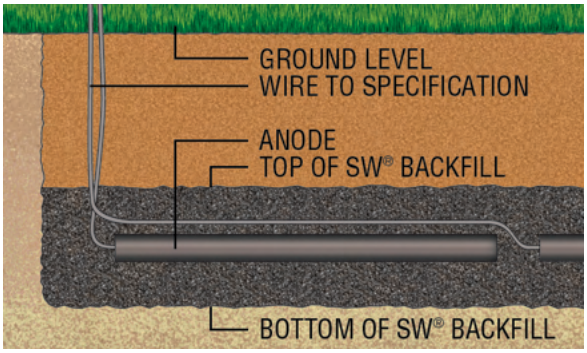
Loresco SW exhibits a hard, round shape and does not require tamping because of its ability to go to full density with simple pouring. The bulk density of SW is 54 lbs. per cubic foot with a porosity of 56.7%. The particle sizing of SW ranges from 1 mm. to 12 mm.

The manufacture of SW is in a highly controlled "hot" atmosphere which produces a particle surface with wettable characteristics. This allows SW to be freely poured directly into water or light mud without sacrificing system integrity due to poorly compacted carbon. Set up time is almost instantaneous. There are no "dedusting oils" allowed in the manufacture of Loresco SW.

Loresco SW is a product designed to be placed in the earth. According to EPA-approved leacherate tests, SW meets all purity requirements for materials utilized in underground burial.

INSTALLATION

Loresco SW may be poured freely in dry applications. If SW is poured through water, the rate should not exceed one-hundred pounds per minute. The rate of pouring should be decreased if the fluid is a light mud.



Typical Horizontal Installation

HORIZONTAL INSTALLATION PROCEDURE

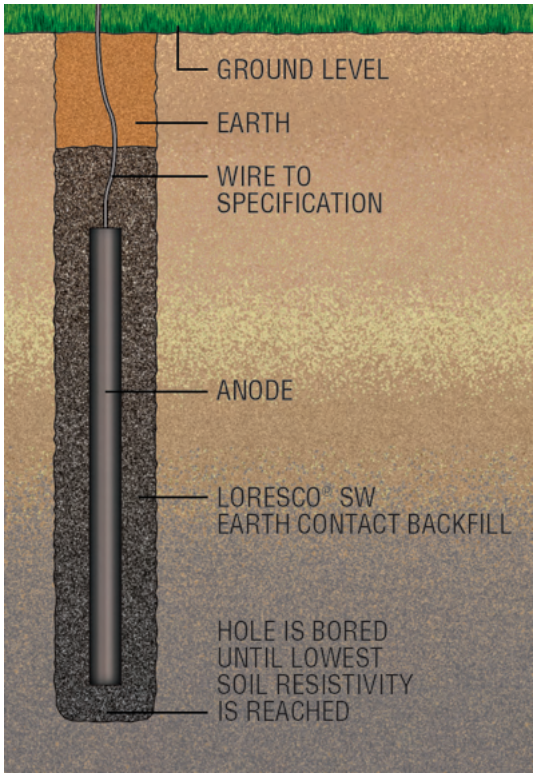
(see illustration)

- Have a reasonably clean ditch (design usually calls for a ditch one foot wide.)
- Pour Loresco SW in a continuous layer six inches deep (or as specified.)
- Place anodes on top of SW.
- Pour SW in a continuous layer until anodes are covered by a six inch backfill cover (or as specified.)
- Fill the remainder of the ditch as specified.

Earth Contact Backfill

VERTICAL INSTALLATION PROCEDURE

- Have a reasonably clean hole (depth depending on soil resistivity).
- Place one foot of SW in bottom of hole.
- Lower and center anode in proper position.
- Pour SW over anode until design level is reached.
- Fill remainder of hole as design specifics.



Typical Vertical Installation

DRY VOLUME OF LORESCO TYPE SW REQUIRED VS. CYLINDRICAL HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	LBS. TYPE SW PER FT.	FT. TYPE SW PER 100 LBS.	LBS. SW PER 100 FT. OF HOLE
4"	.087	4.7	21.30	470
6"	.196	10.6	9.45	1060
8"	.349	18.8	5.30	1880
10"	.545	29.4	3.40	2940
12"	.784	42.3	2.36	4230

SPECIFICATIONS

Fixed Carbon	99.35%
Ash	0.6%
Moisture	0.05%
Volatiles	nil (950°C)*
Bulk Density	54 lbs. per cubic foot
Particle Sizing	Ranging from 1mm to 12mm.

Typical values shown above. Specifications subject to changes without notice.

**Hydrogen / hydrocarbons nil due to calcination temperature in excess of 1200° C*

Visit us online @ www.loresco.com

use our convenient online calculators

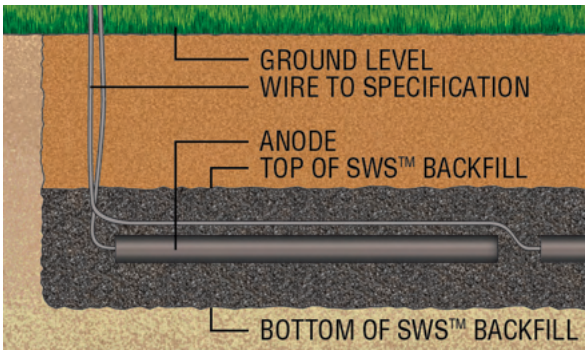
Earth Contact Backfill

Loresco SWS is designed for use in impressed current surface systems. SWS is also suitable for containerized anode systems and semi-deep impressed current systems. SWS is also designed for use around continuous, long-line impressed current anodes.

Loresco SWS is a uniform sized earth contact backfill with 90 percent of the particles between 1mm and 5mm. The bulk density of Loresco SWS is 68 lbs per cubic foot.

The production of SWS begins with the selection of a base material which meets Loresco's exacting standards. Calcination of the base material is strictly controlled according to Loresco's quality control standards. There are no "dedusting oils" allowed in the production of SWS.

The free-flowing properties of Loresco SWS allow the product to be quickly poured into position. Loresco SWS may be poured into water or light mud without sacrificing system integrity due to poorly compacted carbon. Set up time is almost instantaneous.



Typical Horizontal Installation

INSTALLATION

Loresco SWS may be poured freely in dry applications. If SWS is poured through water, the rate should not exceed one-hundred pounds per minute. The rate of pouring should be decreased if the fluid is a light mud.

HORIZONTAL INSTALLATION PROCEDURE

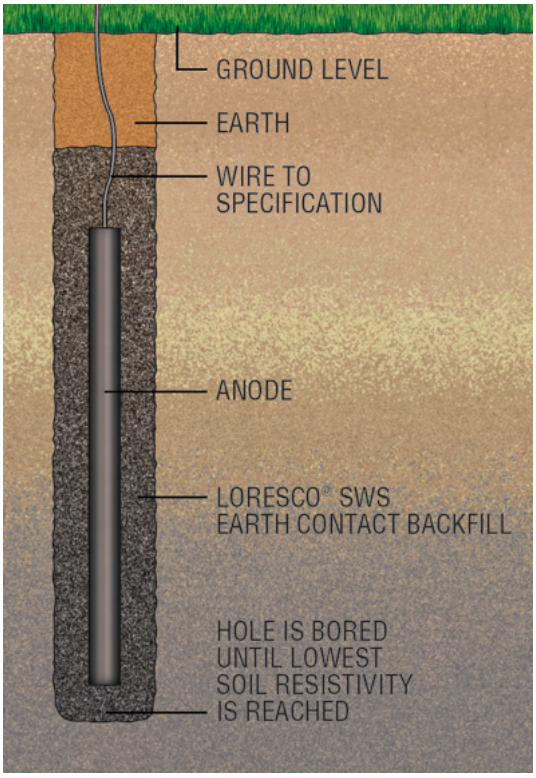
(see illustration)

- Have a reasonably clean ditch (design usually calls for a ditch one foot wide.)
- Pour Loresco SWS in a continuous layer six inches deep (or as specified.)
- Place anodes on top of SWS.
- Pour SWS in a continuous layer until anodes are covered by a six inch backfill cover (or as specified.)
- Fill the remainder of the ditch as specified.

Earth Contact Backfill

VERTICAL INSTALLATION PROCEDURE

- Have a reasonably clean hole (depth depending on soil resistivity).
- Place one foot of SWS in bottom of hole.
- Lower and center anode in proper position.
- Pour SWS over anode until design level is reached.
- Fill remainder of hole as design specifies.



Typical Vertical Installation

DRY VOLUME OF LORESCO TYPE SWS REQUIRED VS. CYLINDRICAL HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	POUNDS TYPE SWS PER FT.	FT. TYPE SWS PER 100 LBS.	LBS. SWS PER 100 FT. OF HOLE
4"	.087	5.9	16.9	590
6"	.196	13.3	7.5	1330
8"	.349	23.7	4.2	2370
10"	.545	37.1	2.7	3710
12"	.784	53.3	1.9	5330

SPECIFICATIONS

Fixed Carbon	99.25%
Ash	0.6%
Moisture	0.05%
Volatiles	nil (950°C)*
Bulk Density	68 lbs. per cubic foot
Particle Sizing	90% between 1mm and 5mm

Typical values shown above. Specifications subject to changes without notice.

**Hydrogen / hydrocarbons nil due to calcination temperature in excess of 1200° C*

Visit us online @ www.loresco.com

use our convenient online calculators

Earth Contact Backfill

ENVIROCOKE IV CONDUCTIVE CARBON GROUT

Designed specifically for use in environmentally sensitive areas.

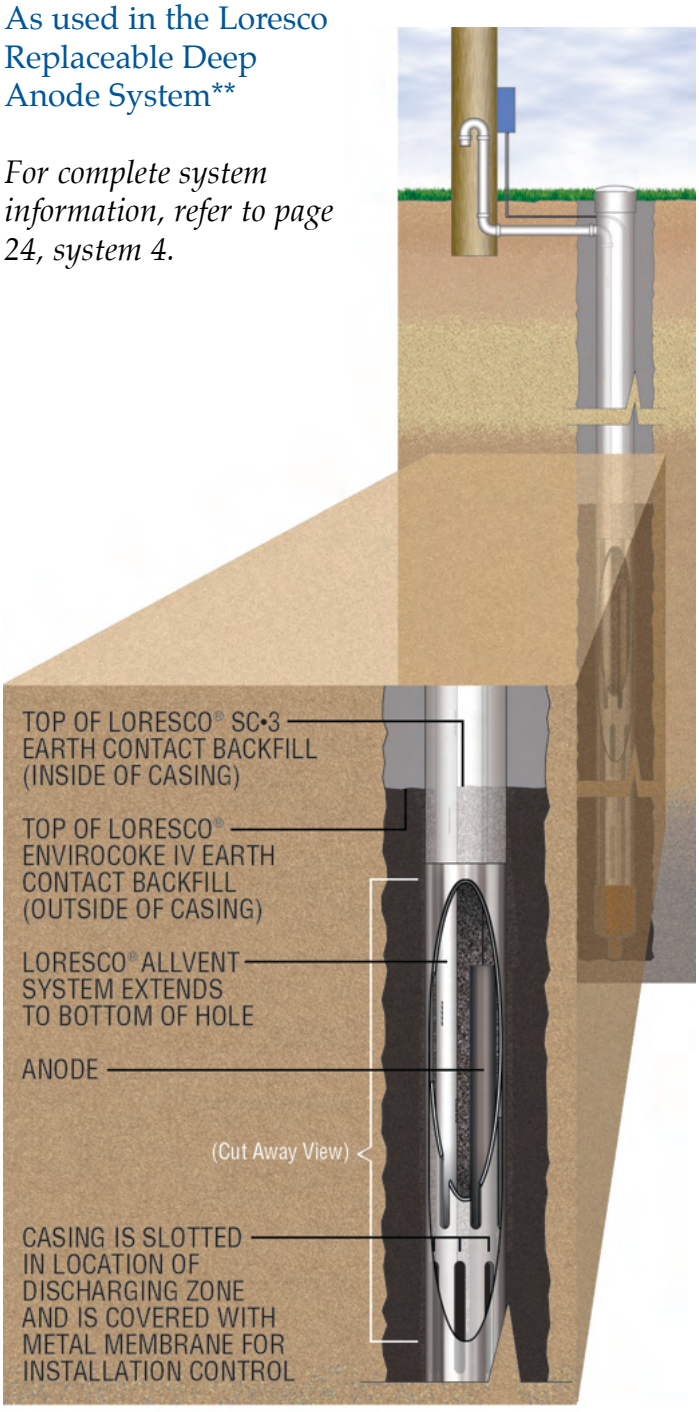
EnviroCoke IV*, the backfill in the Loresco line of products designed specifically for deep cathodic protection systems whose discharge area must include environmentally sensitive zones.

EnviroCoke IV combines the conductive properties of natural round grain Calcined Fluid Petroleum Coke particles with the low permeability properties of grout. The Coke particles are specifically sized to form the main conductive structure of the electrically conductive grout. To enhance the conductivity properties of EnviroCoke IV, other forms of high quality carbon are added to the composite mixture. Further additives make installation easier by minimizing the apparent viscosity of the slurry. The additives insure the compatibility of EnviroCoke IV with equipment normally used to install cathodic protection systems.

EnviroCoke IV is designed specifically for use in the discharging zone on the outside of a conductive casing, with anodes and Loresco SC-3® inside the casing. By placing EnviroCoke IV around the casing on the outside, a conductive seal is formed which serves as an environmental precaution against interchange flow between water bearing formations in the discharging zones. When used in conjunction with PermaPlug,

EnviroCoke IV*
As used in the Loresco Replaceable Deep Anode System**

For complete system information, refer to page 24, system 4.



*(United States Patent No. 5,080,773)

**(United States Patent No. 5,026,508)

total environmental control can be established.

EnviroCoke IV, with its conductivity and ease of installation, provides a solution to environmental concerns pertaining to deep anode installations in sensitive areas.

INSTALLATION

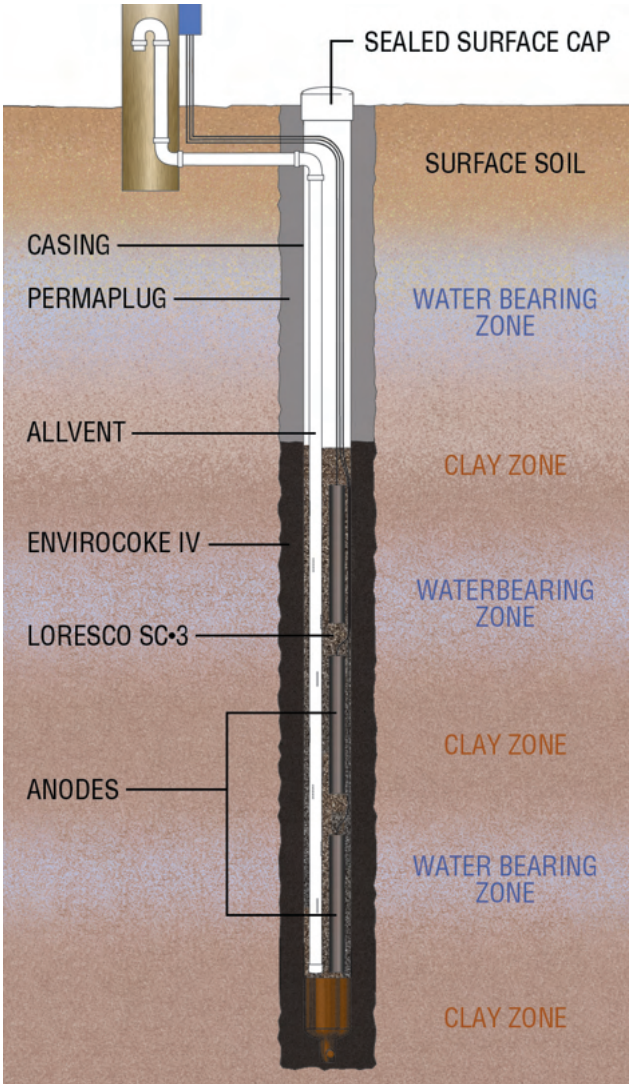
EnviroCoke IV must be pre-mixed thoroughly with water before pumping. Mix 7 gallons of water with each 100 lbs. of EnviroCoke IV. Mixing and placement may be undertaken as a single batch process or in a continuous series fashion. Once installation has started, pumping should not be interrupted. EnviroCoke IV should be placed by pumping from the bottom of the earth hole up using a minimum 1 inch steel placement pipe. Minimum pumping pressure required in a 300 foot deep system is approximately 125 p.s.i. The casing EnviroCoke IV is placed around will be buoyant during installation.

A mud of sufficient weight should be added to the inside of the casing or hold the casing with suitable clamps to prevent floating. EnviroCoke IV becomes structurally stable 24 hours following installation. Clamps or mud may be removed at this time.

EnviroCoke IV is a seal which will minimize water transfer. A vent pipe for the release of gases and as a facility for water addition is recommended. Loresco's AllVent™ is preferred because of it's unique design. It is specifically made for use with the EnviroCoke IV system.

DRY VOLUME OF ENVIRO COKE IV VS. HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAR FT.	LBS. OF ENVIRO COKE IV PER FT.	FT. OF ENVIRO COKE IV PER 100 LBS.	LBS. OF ENVIRO COKE IV PER 100 FT. HOLE
4"	.087	6.4	15.7	640
6"	.196	14.3	6.99	1430
8"	.349	25.5	3.93	2550
10"	.545	39.8	2.51	3980
12"	.784	57.2	1.75	5720



EnviroCoke IV in combination with PermaPlug provides total environmental control.

Replaceable Deep Anode Systems

Standard Designs

System 1

System 2

System 3

Environmentally Sound Design

System 4

Replaceable Deep Anode Systems

THE TRADITION YOU TRUST

REPLACEABLE DEEP ANODE SYSTEMS

Loresco Replaceable Deep Anode Systems are a proven legend. Since 1971, Loresco's Replaceable Deep Systems have performed successfully around the world. The versatility of performance in all field conditions coupled with the simplicity of installation guarantees an economical deep system.

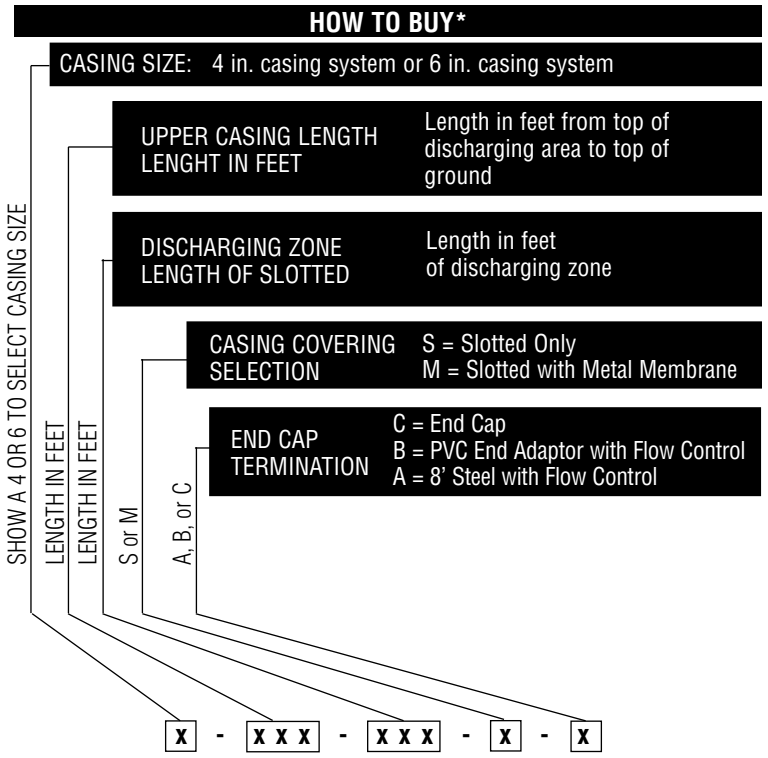
APPLICATION DATA

The Loresco Replaceable Deep Anode System gives the advantage of allowing for the inevitable failure of a deep system to occur without the painful cost of drilling a new hole. The Loresco Replaceable Deep Anode System incorporates simple technology that works to provide proven economical performance.

ECONOMICAL – SIMPLICITY – PROVEN PERFORMANCE

Specify Loresco® Replaceable Deep Anode Systems

Loresco Replaceable Deep Systems are furnished complete with upper zone casing, discharging zone casing, and end termination. Anodes are not included.



** It is assumed a 4 in. system will be installed in an 8 in. bore hole. It is assumed a 6 in. system will be installed in a 10 in. bore hole.*

The following materials may also be furnished by Loresco to make installation simpler and more economical.

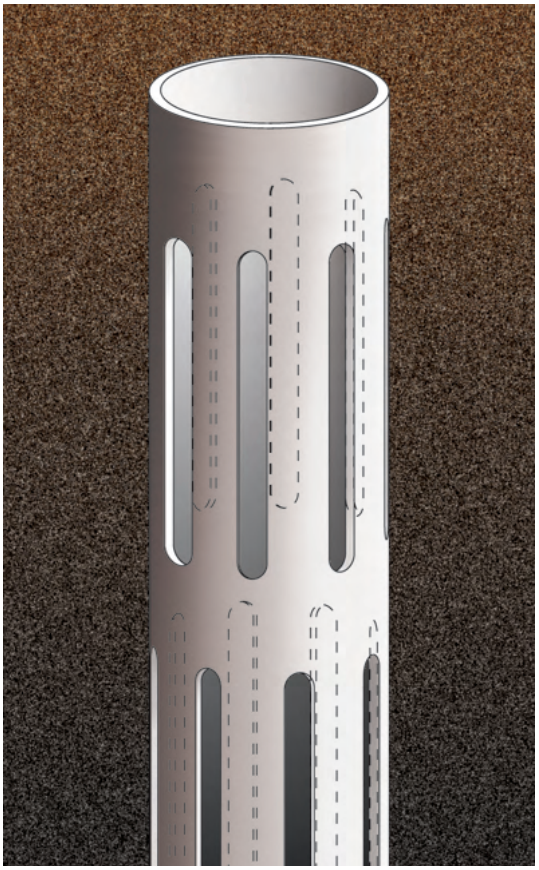
1. **Surface Accessories:** Surface caps and surface boxes. Traffic-rated surface covers also available.
2. **Upper zone earth seal:** Loresco® PermaPlug is an economical and simple to use surface seal. PermaPlug is a naturally produced, environmentally safe bentonite pellet.
3. **Installation accessories:** Includes PVC glue, PVC primer, coupling screws, and right hand left hand nipple. Nipple is not

required if flow control is not used in end termination.

4. Carbon Backfill: Loresco SC•3® is 74 lbs per cu. ft. Sufficient quantity should be purchased to place the top of SC•3 30 ft. above the top of the discharging column.

5. Loresco AllVent™ System (Deep Anode systems should be vented): AllVent and solid casing are available. AllVent should be throughout the discharging zone. Couplings, 90° elbows, and insect guards are available to complete vent system.

The Loresco Replaceable Deep Anode System is made possible by using a non-conductive slotted plastic casing which allows for system rejuvenation if failure occurs.



Typical Slotted Casing

Anodes should be selected to be easily replaced. Small diameter anodes such as mixed metal oxide anodes are ideal for use in a Loresco Replaceable Deep Anode System.

Loresco slotted casing has 224 six inch slots in each 20 foot length. Slots are offset and parallel to the vertical axis of the casing to maximize strength. Slots are .5 in. wide in 4 in. casing and .75 in. wide in 6 in. casing.

Designing A Loresco® Replaceable Deep Anode System

Step 1: Determine total depth. Utilizing all sources available the total depth of the deep system should be determined. See Deep Anode Systems published by Loresco International.

Step 2: Select the lengths and diameter of the upper casing and the length of the discharging zone. The soil conditions and the systems current requirements control this determination. (see table below).

Step 3: Using the system schematics 1-4, select the system design which fits the field conditions of the proposed site.

SLOTTED CASING SIZE VS. CURRENT CAPACITIES

CASING SIZE	RECOMMENDED HOLE SIZE	NORMAL CURRENT OUTPUT	MAXIMUM CURRENT OUTPUT
4 in.	8 in.	0.26 A/FT	0.32 A/FT
6 in.	10 in.	0.33 A/FT	0.46 A/FT

** The slotted casing should be located in uniform zones of low resistivity.*

Replaceable Deep Anode Systems

System 1

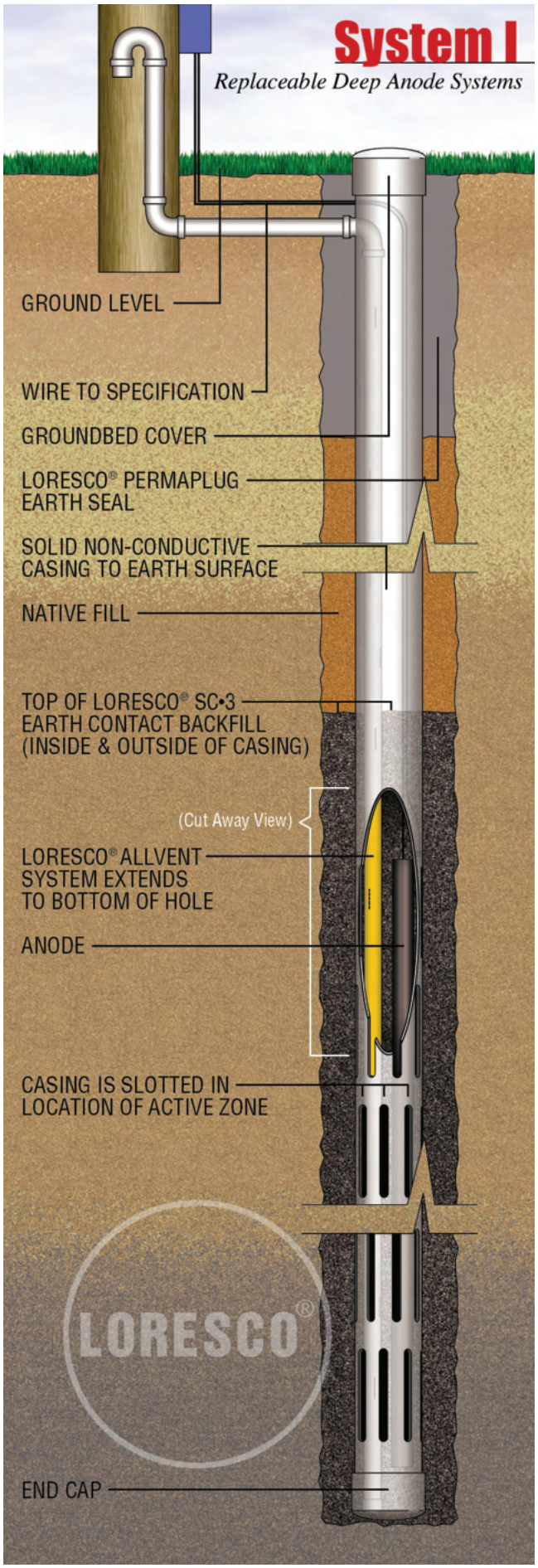
System 1 is the most economical in the array of Loresco Replaceable Deep Anode System selections. Stable drilling conditions which produce a clean, straight hole are required. Simple, proven and innovative technology.

Advantages

1. Simple and economical.
2. Non-conductive casing to surface reduces interference.
3. Mitigates surface water contamination.
4. Proven Replaceability.
5. Easily installed by contractors.

Check List for Installation

- ☑ Ground Bed Cover
- ☑ Loresco PermaPlug Earth Seal
- ☑ Loresco SC•3
- ☑ Slotted Casing
- ☑ Solid Casing
- ☑ Loresco AllVent System
- ☑ End Cap
- ☑ Installation Accessories



Call for Assistance with Quantities - We are Deep Anode Specialists!

Replaceable Deep Anode Systems

System 2

System 2 provides an economical selection of a Loresco Replaceable Deep Anode System while adding installation control. System 2 would be selected if slight or mild obstructions may be encountered during installation. System 2 allows for the casing to be lowered by an inside support pipe. If obstructions are encountered fluid may be circulated through the support pipe to facilitate installation.

Advantages

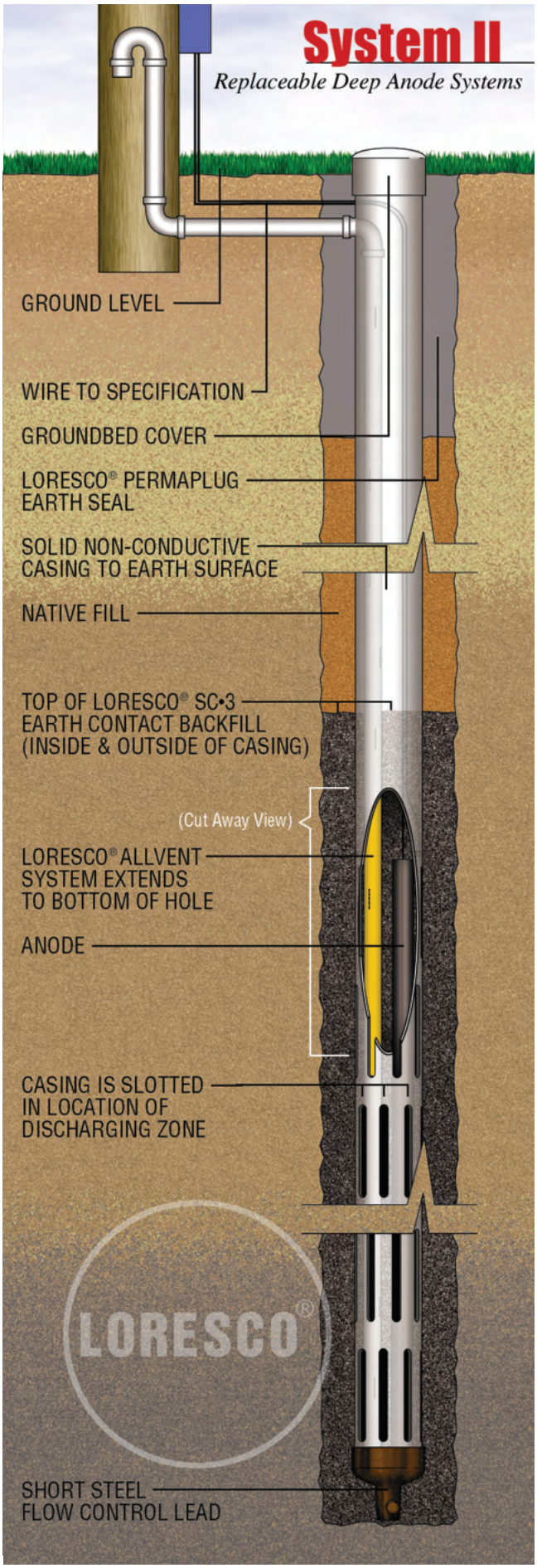
1. Simple and Economical.
2. Mitigates surface water contamination.
3. Non-conductive casing to surface reduces interference.
4. Proven Replaceability.
5. Easily installed by contractors.
6. Simple installation control for varied field conditions.

Check List for Installation

- ☑ Ground Bed Cover
- ☑ Loresco PermaPlug Earth Seal
- ☑ Loresco SC•3
- ☑ Slotted Casing*
- ☑ Solid Casing
- ☑ Loresco AllVent System
- ☑ PVC End Adaptor with Flow Control
- ☑ Installation Accessories

** Slotted casing available with or without metal membrane.*

Call for Assistance with Quantities - We are Deep Anode Specialists!



Replaceable Deep Anode Systems

System 3

System 3 offers maximum control with simplicity of installation. Used in areas with unstable formations the two-stage carbon backfill application assures premium performance. Proven performance with control of backfill placement. See Deep Anode Systems published by Loresco International.

Advantages

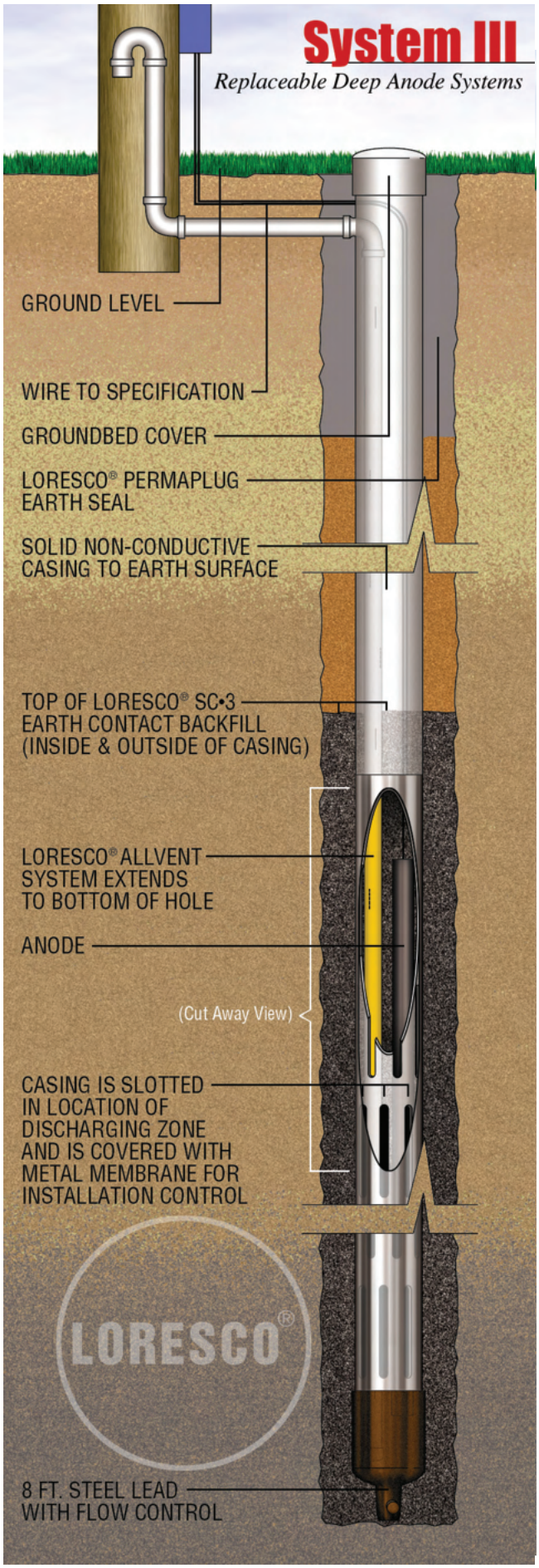
1. Simple Installation.
2. Non-conductive casing to surface reduces interference.
3. Mitigates surface water contamination.
4. Proven Replaceability.
5. Easily installed by contractors.
6. Maximum backfill placement control.

Check List for Installation

- ☑ Ground Bed Cover
- ☑ Loresco PermaPlug Earth Seal
- ☑ Loresco SC•3
- ☑ Slotted Casing with Membrane*
- ☑ Solid Casing
- ☑ Loresco AllVent System
- ☑ 8 ft. Steel Lead with Flow Control
- ☑ Installation Accessories

** Slotted casing available with or without metal membrane.*

Call for Assistance with Quantities - We are Deep Anode Specialists!



Replaceable Deep Anode Systems

System 4*

System 4 is designed for use when deep anode systems are used in environmentally sensitive areas. System 4 utilizes a conductive seal in the active zone as an environmental precaution against interchange flow. Total environmental control of fluid flow is addressed with System 4.

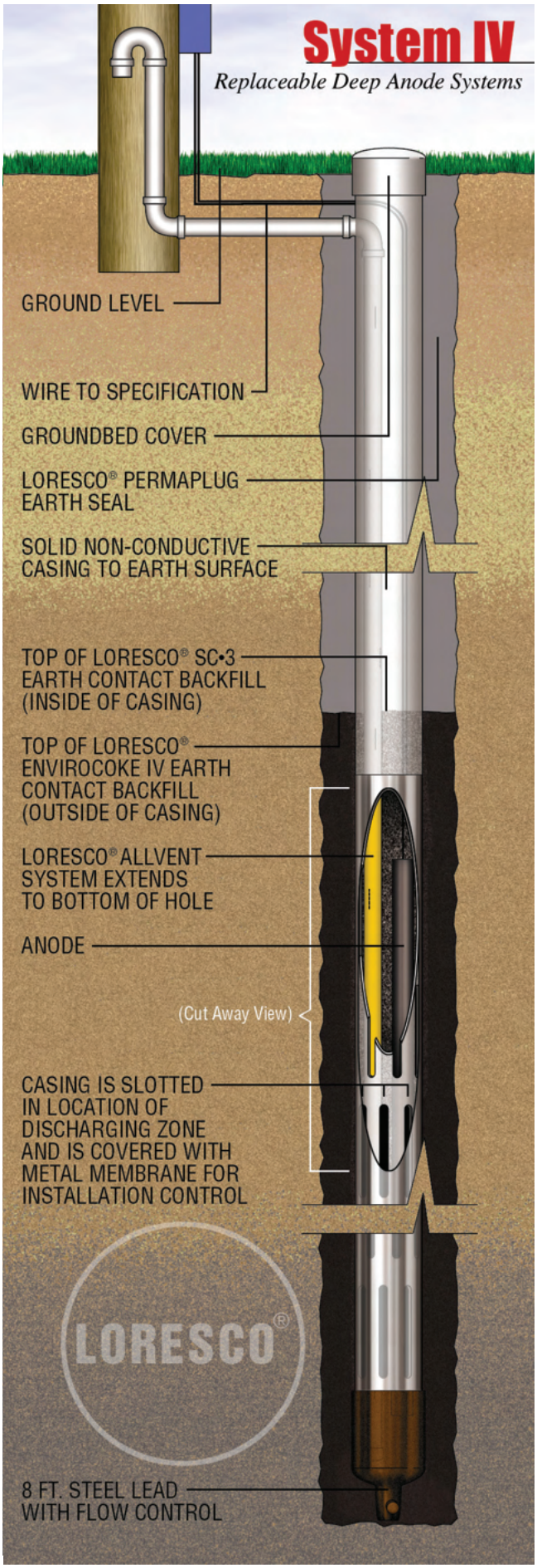
Advantages

1. Non-conductive casing to surface reduces interference.
2. Proven Replaceability.
3. Mitigates surface water contamination.
4. Mitigates interchange flow between water strata.
5. Maximum control of material placement.

Check List for Installation

- ☑ Ground Bed Cover
- ☑ Loresco PermaPlug Earth Seal
- ☑ Loresco SC•3
- ☑ Loresco EnviroCoke IV
- ☑ Solid Casing
- ☑ Slotted Casing with Membrane
- ☑ AllVent System
- ☑ 8 ft. Steel Lead with Flow Control
- ☑ Installation Accessories

**U.S. Patent No. 5026508*



Call for Assistance with Quantities - We are Deep Anode Specialists!

Vent Systems & Sealing Products

AllVent™

PermaPlug

Venting System

ALLVENT™ DEEP ANODE VENT SYSTEM

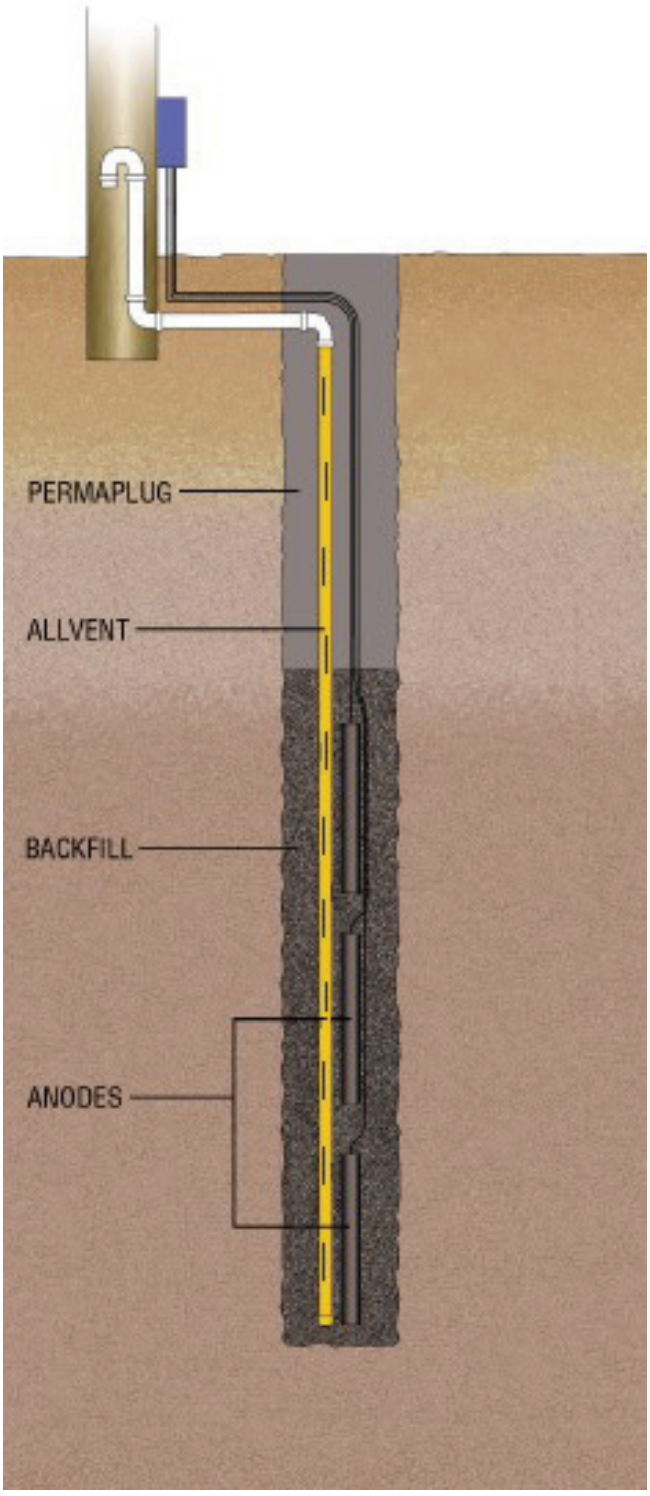
Designed exclusively for use in deep cathodic protection anode systems.

AllVent is a product of premium quality designed exclusively for use in deep cathodic protection anode systems.

AllVent has openings placed in a strategic pattern to allow 360° venting ability without a loss of pipe strength. Vertical slits placed with precision cutting wire produce openings 1.5 inches (3.81 cm) in length with a width of .006 inches (.015 cm). With proper installation, AllVent will vent throughout the life of the deep groundbed.

AllVent is of prime importance when sealing is required on the deep anode system. In addition to venting, AllVent can also be utilized as a conduit for adding water should the system require it.

AllVent's slots are parallel to the longitudinal centerline of the pipe. Center-to-center spacing is 6 inches. Each slot has been placed allowing for a 360° venting ability. Maximum strength is maintained by placement of openings in this pattern.

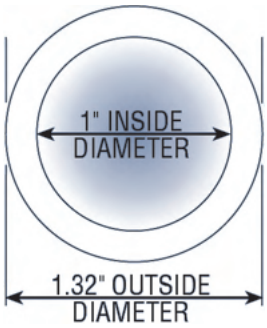


Venting System

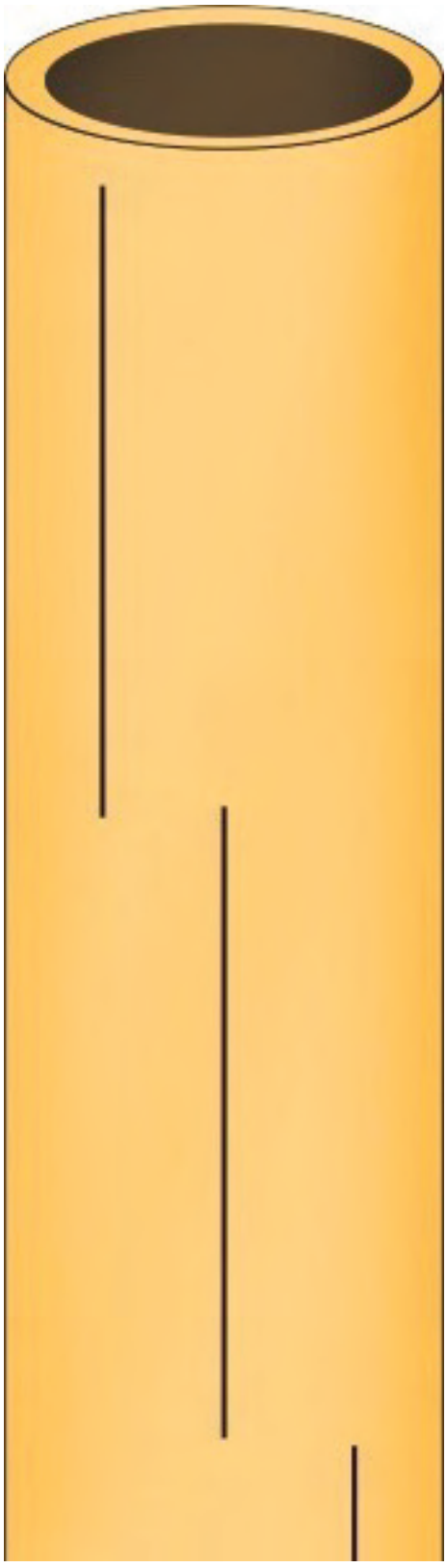
APPLICATION DATA

Place end cap on bottom end of the first AllVent joint to be inserted. Add AllVent joints by gluing couplings together until the length of the discharging anode column is achieved. Add solid pipe until ground level is reached. Add clean water to pipe to facilitate sinking as needed. Do-not allow mud to be sucked into the AllVent system. Maintain surface cap on top of AllVent system during backfill installation. 24 hours after backfill installation, remove the surface cap and finish the system as required.

AllVent is available in ten or twenty foot lengths and has a nominal inside diameter of 1 inch (25.4 mm) with an outside diameter of 1.32 inches (32.3 mm). Special diameters can be produced upon request up to 3 1/2".



Slot spacing in illustration at right is exaggerated to show slot size in relation to AllVent pipe. For actual dimensions, refer to text description of product on page 25.



Sealing Products

PERMAPLUG ENVIRONMENTAL EARTH SEAL

Designed especially for the cathodic protection industry.

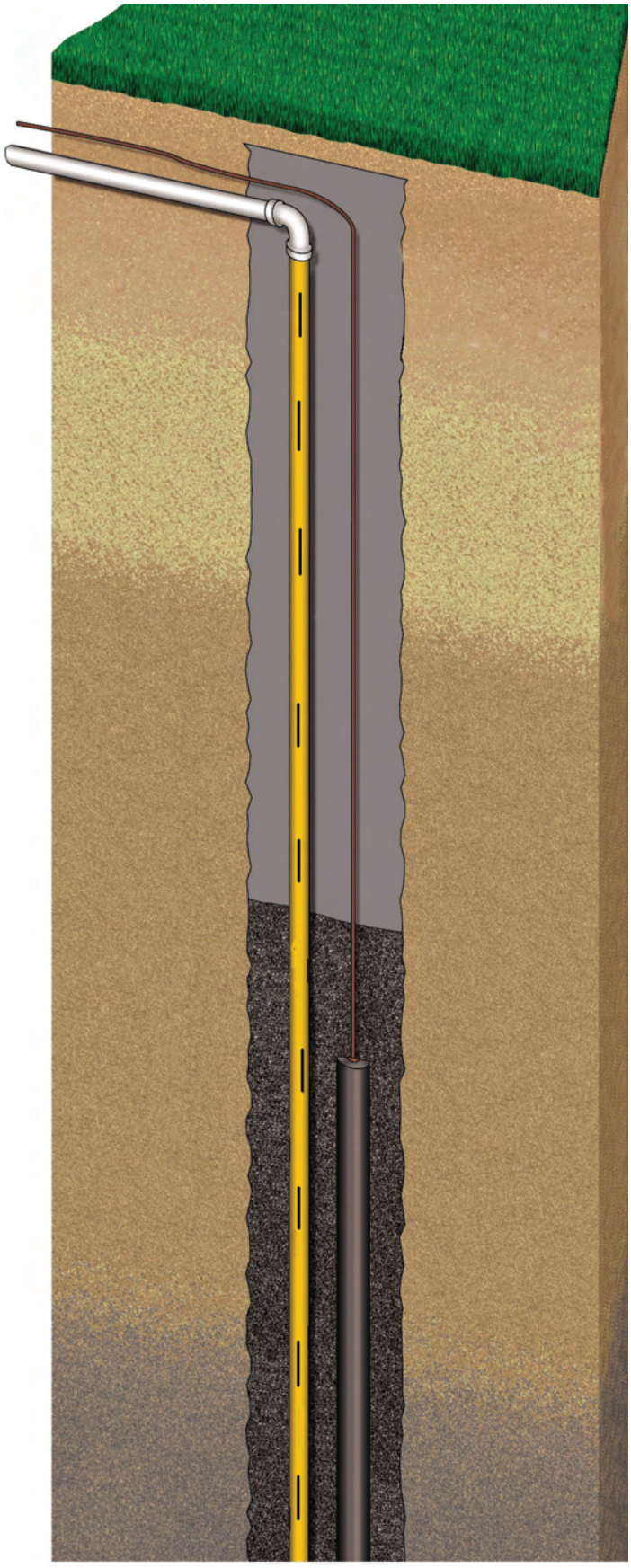
PermaPlug provides the cathodic protection industry with a method to plug and seal earth holes. PermaPlug is environmentally safe and when properly installed, prevents the contamination of underground aquifers from surface fluids.

PermaPlug produces a permanent non-porous molding-clay seal. Manufactured from naturally occurring Bentonite, PermaPlug contains no additional chemicals. Installation is easy requiring no tools or pumps. Simply open the bag and pour.

PermaPlug prevents the deterioration of underground water quality and is environmentally accepted for use in the vicinity of potable drinking water.

PermaPlug requires minimum instruction for proper application.

PermaPlug is inexpensive, easy to install, requires no special tools, and...it works.



Sealing Products

APPLICATION DATA

Condition the earth hole area to be sealed by flushing with clean water or by allowing any drilling fluids to sufficiently thin by overnight settling. The fluid within the earth hole should allow the PermaPlug particles to sink readily. When installing PermaPlug above carbon backfill, insure complete backfill settling before beginning PermaPlug installation. Pour PermaPlug slowly into earth. Install one 50 lb. bag of PermaPlug every 3 to 4 minutes until the desired level is obtained.

Once in place PermaPlug will expand to seal the earth hole: PermaPlug is shipped on stretch wrapped pallets. Each pallet contains 3,500 Ibs. of PermaPlug. Material should not be handled roughly before installation -- fracturing of particles will occur. PermaPlug is shipped in water-resistant bags but must be stored out of the weather due to moisture sensitivity.

Caution: PermaPlug will completely seal earth holes when applied properly. It is strongly advised to utilize a vent pipe for the release of gases and as a facility for water addition if needed. The AllVent breather pipe is recommended. Specifically manufactured for deep cathodic protection systems, AllVent stays open and does not Plug with backfill. For more information and specifications about AllVent, refer to page 25.

DRY VOLUME OF PERMA PLUG VS. HOLE SIZE

HOLE SIZE	CUBIC FT. PER LINEAL FT.	LBS.OF PERMA PLUG. PER FT.	FT. OF PERMA PLUG PER 100 LBS.	LBS. OF PERMA PLUG PER 100' HOLE
4"	.087	6.1	16.4	610
6"	.196	13.7	7.3	1370
8"	.349	24.4	4.1	2440
10"	.545	38.2	2.62	3820
12"	.784	54.9	1.82	5490

PermaPlug in combination with EnviroCoke IV provides total environmental control.

Electrical Grounding Backfill

PowerFill™

PowerSet™

Electrical Grounding Products

PowerFill™ is the economical solution for areas with difficult grounding problems. It is highly conductive wet or dry yet does not require moisture. PowerFill™ carries an NSF certification (Certified to ANSI/NSF standard 60) enabling installation around underground potable water systems.

PowerFill™ is designed to be used in conjunction with all standard copper grounding equipment allowing for a greater variance in design that would otherwise be uneconomical.

Certified to NSF/ANSI/CAN/60

PowerFill™ can be poured in dry or pumped in slurry form. No tamping required. It is very worker friendly. No special tools are required.

ADVANTAGES

- Positive low resistance, electrical connection to the earth.
- Compatible with all copper grounding systems.
- Does not contain any hazardous chemicals.
- Will not leech into the ground.
- Never needs recharging.
- Electronically conductive.
- Environmentally friendly.
- Stable permanent ground for the life of the grounding system.
- Contains a corrosion inhibitor to protect copper.
- Will not expand or experience any shrinkage.
- Not affected by freezing.
- Simple to install.
- Excellent shelf life with no performance effects.

To calculate the amount of material required to fill a trench. **First**, determine your desired thickness of PowerFill™. **Second**, move to the right until you are under the known width of the trench. This number will be the weight of the material lbs/linear ft. Take this number and multiply by the length of the trench in feet. Your answer will be the amount of PowerFill™ material required to fill the trench to the desired level in lbs.

MATERIAL REQUIRED PER LINEAR FOOT OF TRENCH

THICKNESS OF POWERFILL™ (INCHES)	WIDTH OF TRENCH (INCHES)										
	4	6	8	10	12	14	16	18	20	22	24
2	4.1	6.2	8.1	10.1	12.1	14.1	16.2	18.2	20.2	22.2	24.2
3	6.2	9.3	12.1	15.2	18.2	21.2	24.2	27.3	30.3	33.3	36.4
4	8.2	12.3	16.2	20.2	24.2	28.3	32.3	36.4	40.4	44.5	48.5
5	10.3	15.4	20.2	25.3	30.3	35.4	40.4	45.5	50.5	55.6	60.6
6	12.3	18.5	24.2	30.3	36.4	42.4	48.5	54.6	60.6	66.7	72.7
7	14.4	21.6	28.3	35.4	42.4	49.5	56.6	63.7	70.7	77.8	84.9
8	16.4	24.7	32.3	40.4	48.5	56.6	64.7	72.7	80.8	88.9	97.0
9	18.5	27.8	36.4	45.5	54.6	63.7	72.7	81.8	90.9	100.0	109.1
10	20.6	30.8	40.4	50.5	60.6	70.7	80.8	90.9	101.0	111.1	121.2

EXAMPLE:

Thickness = 6 inches Width = 12 inches Answer = 36.4 lbs / linear ft

AMOUNT OF POWERFILL REQUIRED:

36.4 lbs /linear ft x 50 ft of trench = 1820 lbs of PowerFill™

Electrical Grounding Products

VERTICAL INSTALLATION

Drill or dig the earth hole to the desired diameter and depth. Suspend groundrod in center of hole to be filled. Pour PowerFill™ until desired level is obtained. No tamping is necessary.

DRY VOLUME OF POWERFILL VS. HOLE SIZE

HOLE SIZE	LBS. OF POWERFILL PER FT.
4"	6.5
6"	14.5
8"	25.8
10"	40.4
12"	58.1

GROUND RESISTANCE COMPARISON OF BARE ROD VS.

HOLE DIAMETER WITH 5/8 BY 10' ROD IN CENTER OF 15' HOLE	PERCENT RESISTANCE COMPARED TO ROD ONLY (100%)
4"	52%
6"	47%
8"	44%
10"	42%
12"	40%

HORIZONTAL OR GRID CONSTRUCTION*

Pour into horizontal trench until level of ground wire is reached. Place ground wire. Pour in additional PowerFill™ until ground wire is covered to desired height. Cover with fill. No tamping is necessary.

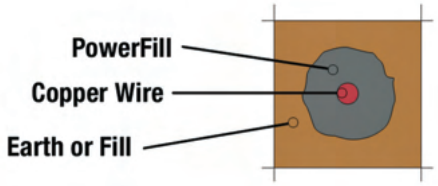
For grid construction, pour PowerFill™ and spread over ground grid until desired thickness is achieved. Cover with fill.

STEADY STATE LEAKAGE RESISTANCE USING 4/0 COPPER WIRE VS. POWERFILL**

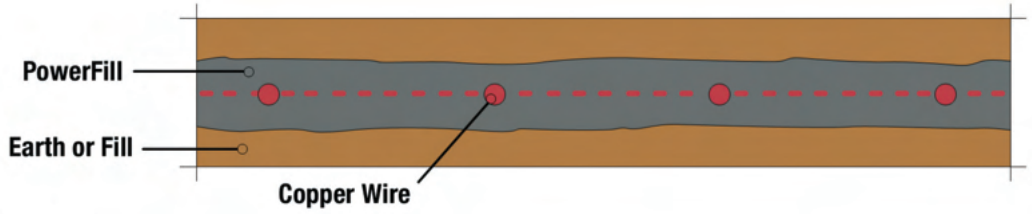
LENGTH	.475" DIAMETER WIRE ONLY	PERCENTAGE OF RESISTANCE WITH .475" WIRE PLUS POWERFILL IN VARIOUS DIAMETERS COMPARED TO WIRE ONLY (100%)			
		2"	3"	4"	6"
25'	100%	83%	78%	74%	69%
50'	100%	85%	81%	77%	73%
75'	100%	86%	82%	79%	75%
100'	100%	87%	83%	80%	77%
150'	100%	88%	84%	82%	78%
200'	100%	88%	85%	83%	79%
250'	100%	89%	85%	83%	80%
300'	100%	89%	86%	84%	80%

*Entire grounding system should be surrounded by PowerFill™ . Conductors should be insulated as they exit the PowerFill™ column.

**The use of PowerFill™ around the grounding system will also reduce surge impedance by increasing the effective contact area of the electrode to soil.



HORIZONTAL CONSTRUCTION



GRID CONSTRUCTION

Electrical Grounding Products

When the specification calls for a hard setting grounding material, PowerSet™ is the product of choice. PowerSet™ is compatible with all standard copper grounding systems and standard field applications. It is an economical permanent solution to difficult grounding problems in hard to deal with areas. PowerSet™ is manufactured from environmentally safe materials and is extremely stable. When mixed with water or exposed to moisture, PowerSet™ attains the hardening characteristics of cement while retaining its highly conductive properties. PowerSet™ will remain highly conductive during a drought or when exposed to arctic temperatures. Because it does not have any shrinkage or expansion properties it will remain in constant contact with the earth.

PowerSet™ can be poured in dry or pumped in slurry form. No tamping is required. It is very worker friendly. No special tools are required.

ADVANTAGES

- Positive low resistance, electrical connection to the earth.
- Compatible with all copper grounding systems.
- Does not contain any hazardous chemicals.
- Will attain a hardened state.
- Will not leech into the ground or wash away.
- Never needs recharging.
- Electronically conductive.
- Environmentally friendly.
- Contains a corrosion inhibitor to protect copper.
- Stable permanent ground for the life of the grounding system.
- Will not expand or experience any shrinkage.
- Not affected by freezing.
- Simple to install.
- Excellent shelf life with no performance effects.

To calculate the amount of material required to fill a trench. **First**, determine your desired thickness of PowerSet™. **Second**, move to the right until you are under the known width of the trench. This number will be the weight of the material lbs / linear ft. Take this number and multiply by the length of the trench in feet. Your answer will be the amount of PowerSet™ material required to fill the trench to the desired level in lbs.

MATERIAL REQUIRED PER LINEAR FOOT OF TRENCH

THICKNESS OF POWERSET™ (INCHES)	WIDTH OF TRENCH (INCHES)										
	4	6	8	10	12	14	16	18	20	22	24
2	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2	18.0	19.7	21.5
3	5.4	8.1	10.8	13.5	16.2	18.8	21.5	24.2	26.9	29.6	32.3
4	7.2	10.8	14.4	18.0	21.5	25.1	28.7	32.3	35.9	39.5	43.1
5	9.0	13.5	18.0	22.4	26.9	31.4	35.9	40.4	44.9	49.4	53.9
6	10.8	16.3	21.5	26.9	32.3	37.7	43.1	48.5	53.9	59.2	64.6
7	12.6	19.0	25.1	31.4	37.7	44.0	50.3	56.5	62.8	69.1	75.4
8	14.4	21.7	28.7	35.9	43.1	50.3	57.4	64.6	71.8	79.0	86.2
9	16.3	24.4	32.3	40.4	48.5	56.5	64.6	72.7	80.8	88.9	96.9
10	18.1	27.1	35.9	44.9	53.9	62.8	71.8	80.8	89.8	98.7	107.7

EXAMPLE:

Thickness = 6 inches Width = 12 inches Answer = 32.3 lbs / linear ft

AMOUNT OF POWERSET REQUIRED:

32.3 lbs /linear ft x 50 ft of trench = 1615 lbs of PowerSet™

Electrical Grounding Products

VERTICAL INSTALLATION

Drill or dig the earth hole to the desired diameter and depth. Suspend groundrod in center of hole. Pour PowerSet™ to desired level. Remove excess water prior to pouring. If necessary, PowerSet™ may be premixed and pumped under water.

DRY VOLUME OF POWERSET VS. HOLE SIZE	
HOLE SIZE	LBS. OF POWERSET PER FT.
4"	5.7
6"	12.8
8"	22.7
10"	35.5
12"	51.1

GROUND RESISTANCE COMPARISON OF BARE ROD VS.	
HOLE DIAMETER WITH 5/8 BY 10' ROD IN CENTER OF 15' HOLE	PERCENT RESISTANCE COMPARED TO ROD ONLY (100%)
4"	52%
6"	47%
8"	44%
10"	42%
12"	40%

HORIZONTAL OR GRID CONSTRUCTION*

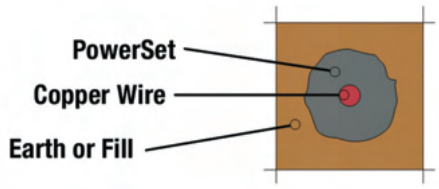
Pour into horizontal trench until level with ground wire. Place ground wire. Pour additional PowerSet™ to desired level. Cover with fill. No tamping is necessary. Remove excess water prior to application.

For grid construction, pour PowerSet™ and spread over ground. Cover with fill. Use ground staples to maintain ground wire in center of fill.

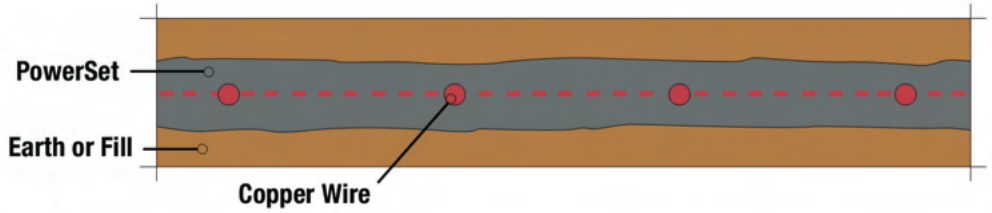
STEADY STATE LEAKAGE RESISTANCE** USING 4/0 COPPER WIRE VS. POWERSET					
LENGTH	.475" DIAMETER WIRE ONLY	PERCENTAGE OF RESISTANCE WITH .475" WIRE PLUS POWERSET IN VARIOUS DIAMETERS COMPARED TO WIRE ONLY (100%)			
		2"	3"	4"	6"
25'	100%	83%	78%	74%	69%
50'	100%	85%	81%	77%	73%
75'	100%	86%	82%	79%	75%
100'	100%	87%	83%	80%	77%
150'	100%	88%	84%	82%	78%
200'	100%	88%	85%	83%	79%
250'	100%	89%	85%	83%	80%
300'	100%	89%	86%	84%	80%

*Entire grounding system should be surrounded by PowerSet™ . Conductors should be insulated as they exit the PowerSet™ column. PowerSet™ should be used as a ground enhancement material when a setting fill is specified.

**The use of PowerSet™ around the grounding system will also reduce surge impedance by increasing the effective contact area of the electrode to soil.



HORIZONTAL CONSTRUCTION



GRID CONSTRUCTION

TABLE OF CONTENTS

INSTALLATION DATA

MECHANICAL DATA

ELECTRICAL DATA

PUMPING LORESCO® TYPE RS.3

A number of different pumping techniques may be employed to successfully pump LORESCO® type RS•3. LORESCO will provide two methods to illustrate the procedure.

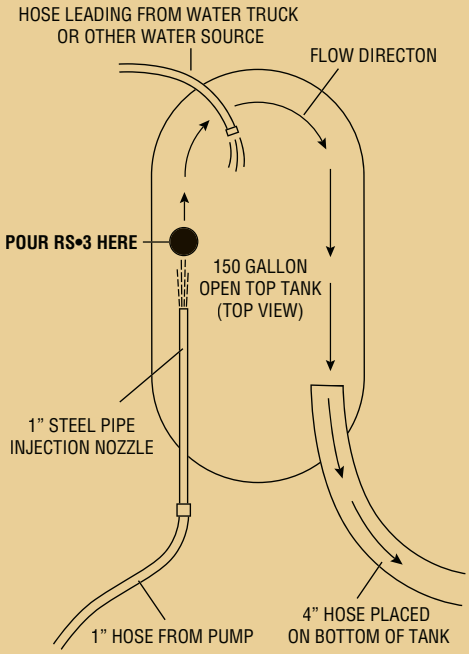
LORESCO recommends the use of a positive displacement pump capable of handling high solids content for pumping. The pump should have a minimum displacement rate of 50 gpm (190 lpm) at a maximum pressure of 150 psi (1000 kPa) or greater for a hole depth of 350 feet (100 m). The maximum pressure available should be greater for deeper holes. A Gardner-Denver duplex 5"x6" piston pump with a maximum flow rate of 150 gpm (570 lpm) at 310 psi (2100 kPa) is an example of a pump with more than sufficient capability. LORESCO recommends a minimum suction of 4 inch nominal (10 cm) with a minimum downhole injection of 1 ¼" nominal pipe size (3 cm).

FLOW STREAM TECHNIQUE

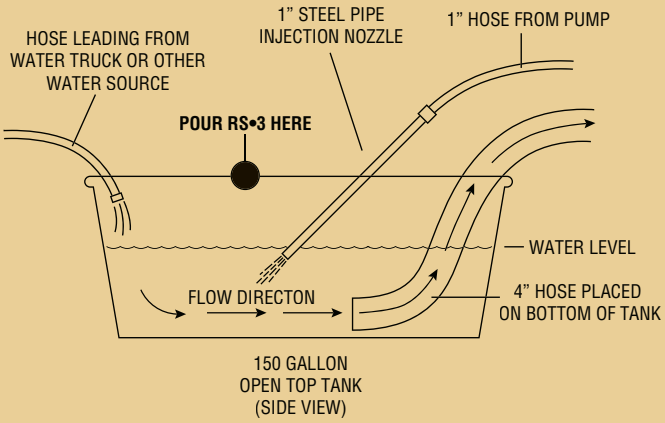
The Flow Stream Pumping technique is based on pouring type RS•3 directly into a water flow stream going directly into the pump suction. For this technique to be successful, the carbon must be wetted quickly and be swept directly into the pump suction. (See schematic.)

Using this technique two flow paths must be established. One closed-loop path through an agitator nozzle and mixing tank is established to facilitate wetting the carbon. The second flow path is established from the mixing tank through the down-hole piping to allow placement of the backfill. Flow through each path is controlled and regulated by in-line flow control valves. The total output from the pump will be divided between the two flow paths in proportion to the flow resistance within each path.

The carbon mixing tank should consist of an open-top tank with a round or oval shape with a capacity of about 150 gallons (500 liters). The closed-loop flow path will be directed into the top of the tank through a nozzle to facilitate agitation and wetting within the tank. The injection nozzle is constructed using a short piece (2 to 3 feet {0.6 to 0.9 m} long) of 1¼(3 cm) in standard black steel pipe coupled to a high-pressure, flexible hose connected to the pump outlet. The injection nozzle will be directed into the top of the tank at an angle of approximately 45 degrees along one side of the tank. The pump suction will be placed at the bottom of the tank along the opposite side. With this arrangement the carbon is poured directly into the water at the end of the agitation nozzle and immediately swept along a path around the tank and into the suction. This wetting flow path for the



FLOW STREAM TECHNIQUE



carbon along the tank bottom from the injection nozzle to the suction should be approximately 3 feet (0.9 m) long to allow adequate carbon wetting prior to being swept into the suction. A clean water inlet must also be provided into the top of the wetting tub with an in-line valve for flow control.

Nominal 3 cm (1 ¼ in) standard black steel pipe is recommended as the minimum size down-hole piping used to pump the backfill into the deep anode system. A transition fitting is necessary to allow coupling the pumping pipe to the drill stem swivel. This arrangement allows the pumping pipe to be supported and retrieved using the drill rig mast, and the carbon slurry to be pumped by the rig mud pump.

To begin the mixing tank is filled with clean water. Both the closed loop and down-hole valves are opened so as to produce sufficient agitation within the mixing tank while flowing approximately 20 gallons per minute (75 lpm) into the down-hole piping. The pump speed will also need to be increased at this point to provide sufficient flow through each path.

When the water in the mixing tank has been pumped down to approximately one-half full, begin to pour type RS•3 directly into the water at the outlet of the injection

nozzle. RS•3 can be poured at a rapid rate at this point as long as the RS•3 is not settling out and building up within the tank. By stirring using a shovel around the suction inlet settling can be detected and rapidly eliminated if necessary. Clean water should be added continuously at the top of the tank to match the pumping rate so that the overall water level is maintained at approximately one-half full. This addition of water and RS•3 is continued until all of the RS•3 has been placed in the tank. After the last RS•3 had been added to the tank, momentarily shut off the incoming water flow to allow slurry in the tank to pump down. Just before the end of the suction hose is exposed, turn the water flow on again at maximum rate to allow approximately 30 gallons (100 l) of clean water to circulate through the pump and down-hole piping (1 ¼ inch pipe).

Immediately after the above clean water has been pumped, the valve controlling the down-hole flow path should be closed and water flow diverted into the tank for adequate pump cleaning. As soon as the down-hole flow valve is closed, removal of the pumping pipe should begin to avoid entrapment of the pipe by the settling RS•3. The pipe removal does not have to be rapid, but does need to be done with continuous, steady progress until the pumping pipe is above the anticipated carbon level.

WATER INJECTION TECHNIQUE

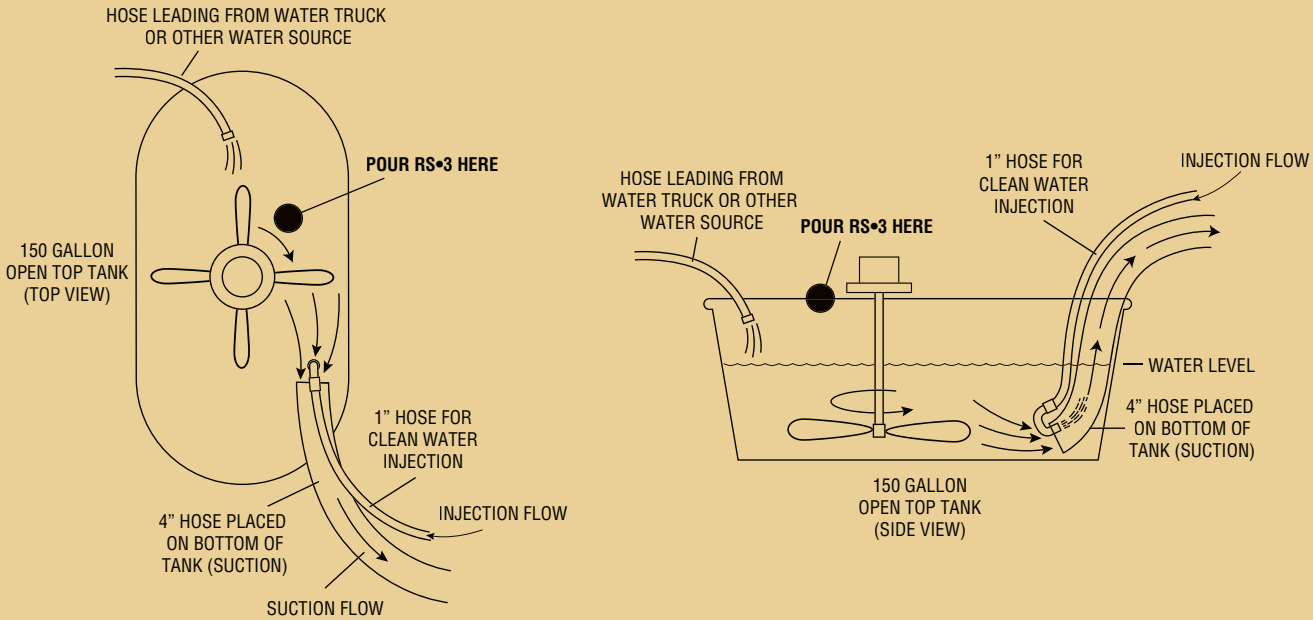
This technique is based on providing a direct clean water injection into the pump suction to aid pumping. Although the RS•3 mixing procedure within the mixing tank is still important, it becomes less critical using this method. With this method a mechanical stirring / agitation is employed to wet the RS•3 using the same type mixing/wetting tank as previously described.

First the pump suction will be modified by installing a 1" (2.5 cm) nominal pipe nipple directly into the end of the suction hose to supply clean water. This can be accomplished by connecting two (2) 1" (2.5 cm) 90 degree u-bends in series to make a 180 degree fitting. This is then coupled to a 1" (2.5 cm) flexible supply hose connected to a clean water supply. With the end of the 1" supply line feeding into the open suction hose, clean water is allowed to gravity flow continuously into the suction stream from a water supply tank as the RS•3 is pumped. (See schematic.)

In the mixing tank the RS•3 can be stirred mechanically using a hydraulically driven motor or manually using men with shovels or by any other technique to mix and force the RS•3 into the suction area. It is important to make sure that the RS•3 does not accumulate in a mass at the suction. This is achieved by continuously agitating the slurry in this area.

CAUTION: Since LORESCO® type RS•3 is designed for rapid, compact settling, the pumping characteristics of this formulation are significantly different from LORESCO® types SC•2 and SC•3. Type RS•3 is NOT designed to remain in fluid suspension for any length of time. Therefore, water mixing techniques commonly used with types SC•2 and SC•3 are NOT effective with type RS•3.

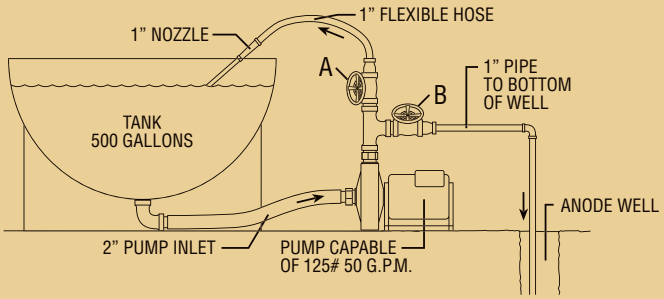
WATER INJECTION TECHNIQUE



PUMPING LORESCO® CARBON BACKFILL

METHOD I

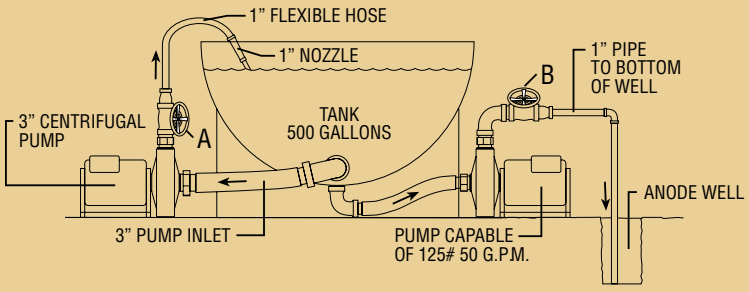
The Loresco is poured into the tank along with the required amount of water. At the same time, the pump is used to stir the mixture by means of the by-pass valve A, valve B is being closed. After the mixture is fluidized, valve B is opened (leaving valve A open also to keep mixture fluidized) and the mixture is pumped to the bottom of the well. Once pumping is commenced it should not be interrupted until all Loresco is in place.



METHOD I	
Tank Capacity:	500 gallons
Pump Size:	50 g.p.m. at 125 psi
Mix Ratio:	7 gallons per 100# LORESCO

METHOD II

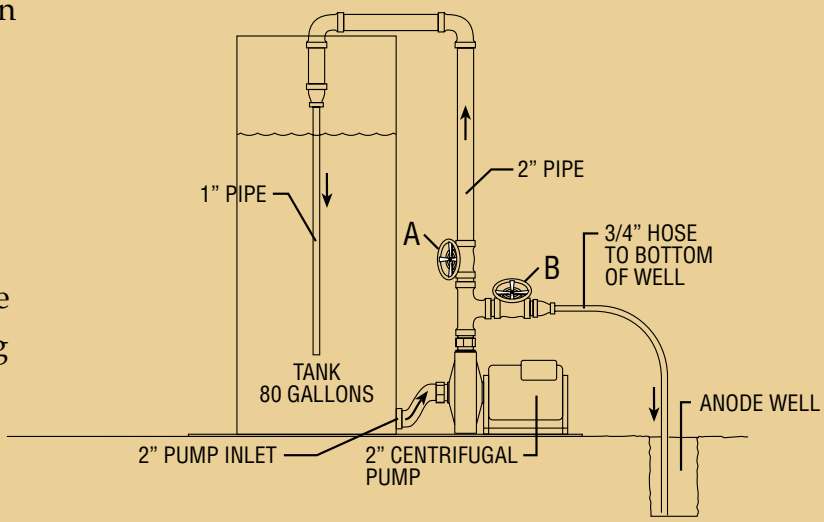
Loresco is poured into the tank along with the required amount of water. At the same time, pump A is used to fluidize the mixture. After mixture is fluidized pump B is used to pump Loresco to the bottom of the well. Pump A should be left running to keep mixture fluidized while pumping. Once pumping is commenced it should not be interrupted until all Loresco is in place.



METHOD II	
Mix Ratio:	7 gallons per 100# LORESCO
Pump A:	3" Centrifugal
Pump B:	50 g.p.m. at 125 psi
Tank Capacity:	500 gallons

METHOD III

Method III may be used to pump Loresco in open holes or casing up to 200 ft. in depth. Strong 3/4" rubber hose with a 5' length of 3/4" pipe attached to the front end for weight may be used to lower into well. A tank of 80 gallon can mix and pump approx. 600 lbs. of Loresco. However, if one adds water and Loresco while the pumping process is going on, a greater amount can be pumped without interruption.



First, the tank is filled approx. 1/2 full for 600 lbs. or proportionately according to the amount of Loresco to be pumped. Valve B is closed and pump is engaged. Water flowing through Valve A agitates tank water while the proper amount of Loresco is added to tank. When mixing is completed valve B is opened and Loresco is pumped down hole. Valve A should be left open to keep mixture agitated while pumping down hole. Once pumping is commenced it should not be interrupted until all Loresco is in place.

METHOD III	
Tank Capacity:	80 gallons
Pump Speed:	10 gpm @ 35 psi
Mix Ratio:	7 gallons per 100# Loresco

SETTING TIME

Sufficient time should be allowed for Loresco to settle. This will take approx. 2 hours for a 200-foot hole. If possible, the bed should be allowed a 24-hour settling period before energizing.

GENERAL INFORMATION

Complete Information on pumping carbon is available in the book Deep Anode Systems Design, Installation and Operation published by Loresco International.

ENGINEERING INFORMATION
English Standard Measures

Long Measure

1 mile = 1760 yards = 5280 feet.

1 yard = 3 feet = 36 inches.

1 foot = 12 inches.

Surveyor's Measure

1 mile = 8 furlongs = 80 chains.

1 furlong = 10 chains = 220 yards.

1 chain = 4 rods = 22 yards = 66 feet = 100 links.

1 link = 7.92 inches.

Square Measure

1 square mile = 640 acres = 6400 square chains.

1 acre = 10 square chains = 4840 square yards = 43,560 square feet.

1 square chain = 16 square rods = 484 square yards = 4356 square feet.

1 square rod = 30.25 square yards = 272.25 square feet = 625 square links.

1 square yard = 9 square feet

1 square foot = 144 square inches.

An acre is equal to a square, the side of which is 208.7 feet.

Dry Measure

1 bushel (U.S. or Winchester struck bushel) = 1.2445 cubic foot = 2150.42 cubic inches.

1 bushel = 4 pecks = 32 quarts = 64 pints.

1 peck = 8 quarts = 16 pints.

1 quart = 2 pints.

1 heaped bushel = 1 1/4 struck bushel.

1 cubic foot = 0.8036 struck bushel.

1 British Imperial bushel = 8 Imperial gallons = 1.2837 cubic foot = 2218.19 cubic inches.

Liquid Measure

1 U.S. gallon = 0.1337 cubic foot = 231 cubic inches = 4 quarts = 8 pints.

1 quart = 2 pints = 8 gills.

1 pint = 4 gills.

1 British Imperial gallon = 1.2003 U.S. gallon = 277.27 cubic inches.

1 cubic foot = 7.48 U.S. gallons.

Circular and Angular Measure

60 seconds (") = 1 minute (').

60 minutes = 1 degree (°).

360 degrees = 1 circumference (C).

57.3 degrees = 1 radian.

2p radians = 1 circumference (C).

Specific Gravity

The specific gravity of a substance is its weight as compared with the weight of an equal bulk of pure water. For making specific gravity determinations the temperature of the water is usually taken at 62°F. when 1 cubic foot of water weighs 62.355 lbs. Water is at its greatest density at 39.2°F. or 4° Centigrade.

Temperature

The following equation will be found convenient for transforming temperature from one system to another:

Let F = degrees Fahrenheit; C = degrees Centigrade;

$$\frac{F-32}{180} = \frac{C}{100}$$

Avoirdupois or Commercial Weight

1 gross or long ton = 2240 pounds.

1 net or short ton = 2000 pounds.

1 pound = 16 ounces = 7000 grains.

1 ounce = 16 drams = 437.5 grains.

Measures of Pressure

1 pound per square inch = 144 pounds per square foot = 0.068 atmosphere = 2.042 inches of mercury at 62 degrees F. = 27.7 inches of water at 62 degrees F. = 2.31 feet of water at 62 degrees F.

1 atmosphere = 30 inches of mercury at 62 degrees F. = 14.7 pounds per square inch = 2116.3 pounds per square foot = 33.95 feet of water at 62 degrees F.

1 foot of water at 62 degrees F. = 62.355 pounds per square foot = 0.433 pound per square inch.

1 inch of mercury at 62 degrees F. = 1.132 foot of water = 13.58 inches or water = 0.491 pound per square inch.

Column of water 12 in. high, 1 in. dia. = .341 lbs

Cubic Measure

1 cubic yard = 27 cubic feet.

1 cubic foot = 1728 cubic inches.

The following measures are also used for wood and masonry:

1 cord of wood = 4 x 4 x 8 feet = 128 cubic feet.

1 perch of masonry = 16 1/2 x 1 1/2 x 1 foot = 24 3/4 cubic feet.

Shipping Measure

For measuring entire internal capacity of a vessel:

1 register ton = 100 cubic feet.

For measurement of cargo:

1 U.S. shipping ton = 40 cubic feet = 32.143 U.S. bushels = 31.16 Imperial bushels.

British shipping ton = 42 cubic feet = 33.75 U.S. bushels = 32.72 Imperial bushels.

Troy Weight, Used for Weighing Gold and Silver

1 pound = 16 ounces = 5760 grains.

1 ounce = 20 pennyweights = 480 grains.

1 pennyweight = 24 grains.

1 carat (used in weighing diamonds) = 3.086 grains.

1 grain Troy = 1 grain avoirdupois = 1 grain apothecaries-caries' weight.

Measure Used for Diameters and Areas of Electric Wires

1 circular inch = area of circle 1 inch in diameter = 0.7854 square inch.

1 circular inch = 1,000,000 circular mils.

1 square inch = 1.2732 circular inch = 1,273,239 circular mils.

A circular mil is the area of a circle 0.001 inch in diam.

Board Measure

One foot board measure is a piece of wood 12 inches square by 1 inch thick, or 144 cubic inches. 1 cubic foot therefore equals 12 feet board measure.

ENGINEERING INFORMATION
Metric System of Measurements

The principal units are the meter for length, the liter for capacity and the gram for weight. The following prefixes are used for sub-divisions and multiples:

milli = 1/1000; centi = 1/100; deci = 1/10; deca = 10; hecto = 100; kilo = 1000.

Measures of Length

10 millimeters (mm.) = 1 centimeter (cm.)

10 centimeters = 1 decimeter (dm.)

10 decimeters = 1 meter (m.)

1000 meters = 1 kilometer (km.)

Measures of Weight

10 milligrams (mg.) = 1 centigram (cg.)

10 centigrams = 1 decigram (dg.)

10 decigrams = 1 gram (g.)

10 grams = 1 decagram (Dg.)

10 decagrams = 1 hectogram (Hg.)

10 hectograms = 1 Kilogram (Kg.)

1000 kilograms = 1 (metric) ton (T.)

Surveyor's Square Measure

100 square meters ($m.^2$) = are (ar.)

100 acres = 1 hectare (har.)

100 hectares = 1 sq. kilometer ($Km.^2$)

Square Measure

100 sq. millimeters ($mm.^2$) = 1 sq. centimeter ($cm.^2$)

100 sq. centimeters = 1 sq. decimeter ($dm.^2$)

100 sq. decimeters = 1 sq. meter ($m.^2$)

Cubic Measure

1000 cu. millimeters ($mm.^3$) = 1 cu. centimeter ($cm.^3$)

1000 cu. centimeters = 1 cu. decimeter ($dm.^3$)

1000 cu. decimeters = 1 cu. meter ($m.^3$)

Dry and Liquid Measure

10 milliliters (ml.) = 1 centiliter (cl.)

10 centiliters = 1 deciliter (dl.)

10 deciliters = 1 liter (l.)

100 liters = 1 hectoliter (Hl.)

1 liter = 1 cubic decimeter = the volume of 1 kilogram of pure water at a temperature of 39.2 degrees F.

Length Conversion Constants for Metric and U.S. Units

Millimeters x .039370 = inches.

Meters x 39.370 = inches.

Meters x 3.2808 = feet.

Meters x 1.09361 = yards.

Kilometers x 3,280.8 = feet.

Kilometers x .62137 = Statute Miles.

Kilometers x .53959 = Nautical Miles.

Inches x 25.4001 = millimeters.

Inches x .0254 = meters.

Feet x .30480 = meters.

Yards x .91440 = meters.

Feet x .0003048 = kilometers.

Statute Miles x 1.60935 = kilometers.

Nautical Miles x 1.85325 = kilometers.

Weight Conversion Constants for Metric and U.S. Units

Grams x 981 = dynes.

Grams x 15.432 = grains.

Grams x .03527 = ounces (Avd.).

Grams x .033818 = fluid ounces (water).

Kilograms x 35.27 = ounces (Avd.).

Kilograms x 2.20462 = pounds (Avd.).

Metric Tons (1000 Kg.) x 1.10231 = Net Ton (2000 lbs.).

Metric Tons (1000 Kg.) x .98421 = Gross Ton (2240 lbs.).

Dynes x .0010193 = grams.

Grains x .0648 = grams.

Ounces (Avd.) x 28.35 = grams.

Fluid Ounces (Water) x 29.57 = grams.

Ounces (Avd.) x .02835 = kilograms.

Pounds (Avd.) x .45359 = kilograms.

Net Ton (2000 lbs.) x .90719 =

Metric Tons (1000 Kg.)

Gross Ton (2240 lbs.) x 1.01605 =

Metric Tons (1000 Kg.).

Area Conversion Constants for Metric and U.S. Units

Square Millimeters x .00155 = square inches.

Square Centimeters x .155 = square inches.

Square Meters x 10.76387 = square feet.

Square Meters x 1.19599 = square yards.

Hectares x 2.47104 = acres.

Square Kilometers x 247.104 = acres.

Square Kilometers x .3861 = square miles.

Square Inches x 645.163 = square millimeters.

Square Inches x 6.45163 = square centimeters.

Square Feet x .0929 = square meters.

Square Yards x .83613 = square meters.

Acres x .40469 = hectares.

Acres x .0040469 = square kilometers.

Square Miles x 2.5899 = square kilometers.

Volume Conversion Constants for Metric and U.S. Units

Cubic Centimeters x .033818 = fluid ounces

Cubic Centimeters x .061023 = cubic inches.

Cubic Centimeters x .271 = fluid drams.

Liters x 61.023 = cubic inches.

Liters x 1.05668 = quarts.

Liters x .26417 = gallons.

Liters x .035317 = cubic feet.

Hectoliters x 26.417 = gallons.

Hectoliters x 3.5317 = cubic feet.

Hectoliters x 2.83794 = bushel (2150.42 cu. in.).

Hectoliters x .1308 = cubic yards.

Cubic Meters x 264.17 = gallons.

Cubic Meters x 35.317 = cubic feet.

Cubic Meters x 1.308 = cubic yards.

Fluid Ounces x 29.57 = cubic centimeters.

Cubic Inches x 16.387 = cubic centimeters.

Fluid Drams x 3.69 = cubic centimeters.

Cubic Inches x .016387 = liters.

Quarts x .94636 = liters.

Gallons x 3.78543 = liters.

Cubic Feet x 28.316 = liters.

Gallons x .0378543 = hectoliters.

Cubic Feet x .28316 = hectoliters.

Bushels (2150.42 cu. in.) x .352379 = hectoliters.

Cubic Yards x 7.645 = hectoliters.

Gallons x .00378543 = cubic meters.

Cubic Feet x .028316 = cubic meters.

Cubic Yards x .7645 = cubic meters.

Power and Heat Conversion Constants for Metric and U.S. Units

Calorie x 0.003968 = B.T.U.

Joules x .7373 = foot pounds.

Kilogrammeters x 7.233 = foot pounds.

Cheval Vapeur x .9863 = Horsepower.

Kilowatts x 1.34 = Horsepower.

Kilowatt Hours x 3415 = B.T.U.

(Degrees Cent. x 1.8) + 32 = degrees Fahr.

(Degrees Reamur x 2.25) + 32 = degrees Fahr.

B.T.U. x 252 = calories.

Foot Pounds x 1.3563 = joules.

Foot Pounds x .13825 = kilogrammeters.

Horsepower x 1.014 = Cheval Vapeur.

Horsepower x .746 = kilowatts.

B.T.U. x .00029282 = kilowatt hours.

(Degrees Fahr. - 32) x .555 = degrees Cent.

(Degrees Fahr. - 32) x .444 = degrees Reamur.

CONVERSION FACTORS

TO OBTAIN	MULTIPLY	BY
Acres	Sq miles	640.0
Atmospheres	Cm of Hg @ 0 deg C	0.013158
Atmospheres	Ft of H_20 @ 39.2 F	0.029499
Atmospheres	Grams/sq cm	0.00096784
Atmospheres	In. Hg @ 32 F	0.033421
Atmospheres	In. H_20 @ 39.2 F	0.0024583
Atmospheres	Pounds/sq ft	0.00047254
Atmospheres	Pounds/sq in.	0.068046
Btu	Ft-lb	0.0012854
Btu	Hp-hr	2545.1
Btu	Kg-cal.	3.9685
Btu	Kw-hr	3413.0
Btu	Watt-hr	3.4130
Btu/(cu ft) (hr)	Kw/liter	96,650.6
Btu/hr	Mech. hp	2545.1
Btu/hr	Kw	3413.0
Btu/hr	Tons of refrigeration	12,000
Btu/hr	Watts	3.4137
Btu/kw hr	Kg cal/kw hr	3.9685
Btu/(hr) (ft) (deg F)	Cal/(sec) (cm) (deg C)	241.90
Btu/(hr) (ft) (deg F)	Joules/(sec) (cm) (deg C)	57.803
Btu/(hr) (ft) (deg F)	Watts/(cm) (deg C)	57.803
Btu/(hr) (sq ft)	Cal/(sec) (sq cm)	13,273.0
Btu/min	Ft-lb/min	0.0012854
Btu/min	Mech. hp	42.418
Btu/min	Kw	56.896

TO OBTAIN	MULTIPLY	BY
Btu/lb	Cal/gram	1.8
Btu/lb	Kg cal/kg	1.8
Btu/(lb) (deg F)	Cal/(gram) (deg C)	1.0
Btu/(lb) (deg F)	Joules/(gram) (deg C)	0.23889
Btu/sec	Mech. hp	0.70696
Btu/sec	Mech. hp (metric)	0.6971
Btu/sec	Kg-cal/hr	0.0011024
Btu/sec	Kw	0.94827
Btu/sq ft	Kg-cal/sq meter	0.36867
Calories	Ft-lb	0.32389
Calories	Joules	0.23889
Calories	Watt-hr	860.01
Cal/(cu cm) (sec)	Kw/liter	0.23888
Cal/gram	Btu/lb	0.55556
Cal/(gram) (deg C)	Btu/(lb) (deg F)	1.0
Cal/(sec) (cm) (deg C)	Btu/(hr) (ft) (deg F)	0.0041336
Cal/(sec) (sq cm)	Btu/(hr) (sq ft)	0.000075341
Cal/(sec) (sq cm) (deg C)	Btu/(hr) (sq ft) (deg F)	0.0001355
Centimeters	Inches	2.540
Centimeters	Microns	0.0001
Centimeters	Mils	0.002540
Cm of Hg @ 0 deg C	Atmospheres	76.0
Cm of Hg @ 0 deg C	Ft of H_20 @ 39.2 F	2.242
Cm of Hg @ 0 deg C	Grams/sq cm	0.07356
Cm of Hg @ 0 deg C	In. of H_20 @ 4 C	0.1868
Cm of Hg @ 0 deg C	Lb/sq in.	5.1715
Cm of Hg @ 0 deg C	Lb/sq ft.	0.035913

TO OBTAIN	MULTIPLY	BY
Cm/deg C	In./deg F	4.5720
Cm/sec	Ft/min	0.508
Cm/sec	Ft/sec	30.48
Cm/(sec) (sec)	Gravity	980.665
Cm of H_20 @ 39.2 F	Atmospheres	1033.24
Cm of H_20 @ 39.2 F	Lb/sq in.	70.31
Centipoises	Centistokes	Density
Centistikes	Centipoises	1/density
Cu cm	Cu ft	28,317
Cu cm	Cu in.	16.387
Cu cm	Gal. (USA, liq.)	3785.43
Cu cm	Liters	1000.03
Cu cm	Ounces (USA, liq.)	29.573730
Cu cm	Quarts (USA, liq.)	946.358
Cu cm/sec	Cu ft/min	472.0
Cu ft	Cords (wood)	128.0
Cu ft	Cu meters	35.314
Cu ft	Cu yards	27.0
Cu ft	Gal.(USA, liq.)	0.13368
Cu ft	Liters	0.03532
Cu ft/min	Cu meters/sec	2118.9
Cu ft/min	Gal. (USA, liq./sec)	8.0192
Cu ft/lb	Cu meters/kg	16.02
Cu ft/lb	Liters/kg	0.01602
Cu ft/sec	Cu meters/min	0.5886
Cu ft/sec	Gal. (USA, liq.)/min	0.0022280
Cu ft/sec	Liters/min	0.0005886
Cu in.	Cu centimeters	0.061023

TO OBTAIN	MULTIPLY	BY
Cu in.	Gal. (USA, liq.)	231.0
Cu in.	Liters	61.03
Cu in.	Ounces (USA, liq.)	1.805
Cu meters	Cu ft	0.028317
Cu meters	Cu yards	0.7646
Cu meters	Gal. (USA, liq.)	0.0037854
Cu meters	Liters	0.001000028
Cu meters/hr	Gal./min	0.22712
Cu meters/kg	Cu ft/lb	0.062428
Cu meters/min	Cu ft/min	0.02832
Cu meters/min	Gal./sec	0.22712
Cu meters/sec	Gal./min	0.000063088
Cu yards	Cu meters	1.3079
Dynes	Grams	980.66
Dynes	Pounds (avior.)	444820.0
Dyne-centimeters	Ft-lb	13,558,000
Dynes/sq cm	Lb/sq in.	68947
Ergs	Joules	10,000,000
Feet	Meters	3.281
Ft of H_20 @ 39.2 F	Atmospheres	33.899
Ft of H_20 @ 39.2 F	Cm of Hg @ 0 deg C	0.44604
Ft of H_20 @ 39.2 F	In. of Hg @ 32 deg F	1.1330
Ft of H_20 @ 39.2 F	Lb/sq ft	0.016018
Ft of H_20 @ 39.2 F	Lb/sq in.	2.3066
Ft/min	Cm/sec	1.9685
Ft/min	Miles (USA, statute)/hr	88.0
Ft/sec	Knots	1.6889

TO OBTAIN	MULTIPLY	BY
Ft/sec	Meters/sec	3.2808
Ft/sec	Miles (USA, statute)/hr	1.4667
Ft/(sec) (sec)	Gravity (sea level)	32.174
Ft/(sec) (sec)	Meters/(sec) (sec)	3.2808
Ft-lb	Btu	778.0
Ft-lb	Joules	0.73756
Ft-lb	Kg-calories	3087.4
Ft-lb	Kw-hr	2,655,200
Ft-lb	Mech. hp-hr	1,980,000
Ft-lb/min	Btu/min	778.0
Ft-lb/min	Kg cal/min	3087.4
Ft-lb/min	Kw	44,254.0
Ft-lb/min	Mech. hp	33,000
Ft-lb/sec	Btu/min	12.96
Ft-lb/sec	Kw	737.56
Ft-lb/sec	Mech. hp	550.0
Gal. (Imperial, liq.)	Gal. (USA, liq.)	0.83268
Gal. (USA, liq.)	Barrels (petroleum, USA)	42
Gal. (USA, liq.)	Cu ft	7.4805
Gal. (USA, liq.)	Cu meters	264.173
Gal. (USA, liq.)	Cu yards	202.2
Gal. (USA, liq.)	Gal. (Imperial, liq.)	1.2010
Gal. (USA, liq.)	Liters	0.2642
Gal. (USA, liq.)/min	Cu ft/sec	448.83
Gal. (USA, liq.)/min	Cu meters/hr	4.4029
Gal. (USA, liq.)/sec	Cu ft/min	0.12468
Gal. (USA, liq.)/sec	Liters/min	0.0044028
Grains	Grams	15.432

TO OBTAIN	MULTIPLY	BY
Grains	Ounces (avior.)	437.5
Grains	Pounds (avior.)	7000
Grains/gal. (USA, liq.)	Parts/million	0.0584
Grams	Grains	0.0648
Grams	Ounces (avior.)	28.350
Grams	Pounds (avior.)	453.5924
Grams/cm	Pounds/in.	178.579
Grams/(cm) (sec)	Centipoises	0.01
Grams/cu cm	Lb/cu ft	0.016018
Grams/cu in.	Lb/cu in.	27.680
Grams/cu cm	Lb/gal.	0.119826
Gravity (at sea level)	Ft/(sec) (sec)	0.03108
Inches	Centimeters	0.3937
Inches	Microns	0.00003937
Inches of Hg @ 32 F	Atmospheres	29.921
Inches of Hg @ 32 F	Ft of H_20 @ 39.2 F	0.88265
Inches of Hg @ 32 F	Lb/sq in.	2.0360
Inches of Hg @ 32 F	In. of H_20 @ 4 C	0.07355
Inches of H_20 @ 4 C	In. of Hg @ 32 F	13.60
Inches of H_20 @ 39.2 F	Lb/sq in.	27.673
Inches/deg F	Cm/deg C	0.21872
Joules	Btu	1054.8
Joules	Calories	4.186
Joules	Ft-lb	1.35582
Joules	Kg-meters	9.807
Joules	Kw-hr	3,600,000
Joules	Mech. hp-hr	2,684,500

TO OBTAIN	MULTIPLY	BY
Kg	Pounds (avior.)	0.45359
Kg-cal	Btu	0.2520
Kg-cal	Ft-lb	0.00032389
Kg-cal	Joules	0.0002389
Kg-cal	Kw-hr	860.01
Kg-cal	Mech. hp-hr	641.3
Kg-cal/kg	Btu/lb	0.5556
Kg-cal/kw hr	Btu/kw hr	0.2520
Kg-cal/min	Ft-lb/min	0.0003239
Kg-cal/min	Kw	14.33
Kg-cal/min	Mech. hp	10.70
Kg-cal/sq meter	Btu/sq ft	2.712
Kg/cu meter	Lb/cu ft	16.018
Kg/(hr) (meter)	Centipoises	3.60
Kg/liter	Lb/gal. (USA, liq.)	0.11983
Kg/meter	Lb/ft	1.488
Kg/sq cm	Atmospheres	1.0332
Kg/sq cm	Lb/sq in.	0.0703
Kg/sq meter	Lb/sq ft	4.8824
Kg/sq meter	Lb/sq in.	703.07
Km	Miles (USA, statute)	1.6093
Kw	Btu/min	0.01758
Kw	Ft-lb/min	0.00002259
Kw	Ft-lb/sec	0.00135582
Kw	Kg-cal/hr	0.0011628
Kw	Kg-cal/min	0.069767
Kw	Mech. hp	0.7457
Kw-hr	Btu	0.000293

TO OBTAIN	MULTIPLY	BY
Kw-hr	Ft-lb	0.0000003766
Kw-hr	Kg-cal	0.0011628
Kw-hr	Mech. hp-hr	0.7457
Knots	Ft/sec	0.5921
Knots	Miles/hr	0.8684
Liters	Cu ft	28.316
Liters	Cu in.	0.01639
Liters	Cu meters	999.973
Liters	Gal. (Imperial, liq.)	4.546
Liters	Gal. (USA, liq.)	3.78533
Liters/kg	Cu ft/lb	62.42621
Liters/min	Cu ft/sec	1699.3
Liters/min	Gal. (USA, liq.)/min	3.785
Liters/sec	Cu ft/min	0.47193
Liters/sec	Gal./min	0.063088
Mech. hp	Btu/hr	0.0003929
Mech. hp	Btu/min	0.023575
Mech. hp	Ft-lb sec	0.0018182
Mech. hp	Kg-cal/min	0.093557
Mech. hp	Kw	1.3410
Mech. hp-hr	Btu	0.00039292
Mech. hp-hr	Ft-lb	0.00000050505
Mech. hp-hr	Kg-calories	0.0015593
Mech. hp-hr	Kw-hr	1.3410
Meters	Feet	0.3048
Meters	Inches	0.0254
Meters	Miles (Int., nautical)	1852.0
Meters	Miles (USA, statute)	1609.344

TO OBTAIN	MULTIPLY	BY
Meters/min	Ft/min	0.3048
Meters/min	Miles (USA, statute)/hr	26.82
Meters/sec	Ft/sec	0.3048
Meters/sec	Km/hr	0.2778
Meters/sec	Knots	0.5148
Meters/sec	Miles (USA, statute)/hr	0.44704
Meters/(sec) (sec)	Ft/(sec) (sec)	0.3048
Microns	Inches	25,400
Microns	Mils	25.4
Miles (Int., nautical)	Km	0.54
Miles (Int., nautical)	Miles (USA, statute)	0.8690
Miles (Int., nautical)/hr	Knots	1.0
Miles (USA, statute)	Km	0.6214
Miles (USA, statute)	Meters	0.0006214
Miles (USA, statute)	Miles (Int., nautical)	1.151
Miles (USA, statute)	Knots	1.151
Miles (USA, statute)/hr	Ft/min	0.11364
Miles (USA, statute)/hr	Ft/sec	0.68182
Miles (USA, statute)/hr	Meters/min	0.03728
Miles (USA, statute)/hr	Meters/sec	2.2369
Milliliters/gram	Cu ft/lb	62.42621
Millimeters	Microns	0.001
Mils	Centimeters	393.7
Mils	Inches	1000
Mils	Microns	0.03937
Minutes	Radians	3437.75
Ounces (avior.)	Grains (avior.)	0.0022857
Ounces (avior.)	Grams	0.035274

TO OBTAIN	MULTIPLY	BY
Ounces (USA, liq.)	Gal. (USA, liq.)	128.0
Parts/million	Gr/gal. (USA, liq.)	17.118
Percent grade	Ft/100 ft	1.0
Pounds (avior.)	Grains	0.0001429
Pounds (avior.)	Grams	0.0022046
Pounds (avior.)	Kg	2.2046
Pounds (avior.)	Tons, long	2240
Pounds (avior.)	Tons, metric	2204.6
Pounds (avior.)	Tons, short	2000
Pounds/cu ft	Grams/cu cm	62.428
Pounds/cu ft	Kg/cu meter	0.062428
Pounds/cu ft	Pounds/gal.	7.48
Pounds/cu in.	Grams/cu cm	0.036127
Pounds/ft	Kg/meter	0.67197
Pounds/hr	Kg/min	132.28
Pounds/(hr) (ft)	Centipoises	2.42
Pounds/inch	Grams/cm	0.0056
Pounds/(sec) (ft)	Centipoises	0.000672
Pounds/sq inch	Atmospheres	14.696
Pounds/sq inch	Cm of Hg @ 0 deg C	0.19337
Pounds/sq inch	Ft of H_20 @ 39.2 F	0.43352
Pounds/sq inch	In. Hg @ 32 F	0.491
Pounds/sq inch	In. H_20 @ 39.2 F	0.0361
Pounds/sq inch	Kg/sq cm	14.223
Pounds/sq inch	Kg/sq meter	0.0014223
Pounds/gal. (USA, liq.)	Kg/liter	8.3452
Pounds/gal. (USA, liq.)	Pounds/cu ft	0.1337
Pounds/gal. (USA, liq.)	Pounds/cu inch	231

TO OBTAIN	MULTIPLY	BY
Quarts (USA, liq.)	Cu cm	0.0010567
Quarts (USA, liq.)	Cu in.	0.01732
Quarts (USA, liq.)	Liters	1.057
Sq centimeters	Sq ft	929.0
Sq centimeters	Sq inches	6.4516
Sq ft	Acres	43,560
Sq ft	Sq meters	10.764
Sq inches	Sq centimeters	0.155
Sq meters	Acres	4046.9
Sq meters	Sq ft	0.0929
Sq miles (USA, statute)	Acres	0.001562
Sq mils	Sq cm	155,000
Sq mils	Sq inches	1,000,000
Tons (metric)	Tons (short)	0.9072
Tons (short)	Tons (metric)	1.1023
Watts	Btu/sec	1054.8
Yards	Meters	1.0936

WEIGHTS OF MATERIALS

Material	Lbs. per cu. ft	Material	Lbs. per cu. ft
Air*	0.0809	carbon	125-144
acetylene gas*	0.0733	" bisulphide	80.6
alabaster	168	" dioxide*	0.124
alcohol	49-57	" monoxide*	0.0782
aluminum, pure	168	celluloid	90
" cast	160	cement, loose	80-90
" wire	168	" set	168-187
amber	67	cerium	437
ammonia*	0.0482	chalk	119-175
antimony	414	charcoal	17-35
argon*	0.113	chlorine*	0.196
arsenic	357	chromium	368
asbestos	125-175	clay, hard	129-133
asphaltum	69-94	" , soft	118
		coal, anthracite	81-106
		" " loose	47-58
Barium	234	" bituminous	78-88
basalt	180	" " loose	44-54
bismuth	609	" lignite	52
boron	159	cobalt	530-563
brass	510-542	coke	62-105
brick	100-150	" loose	23-32
bromine	196	columbium	452
bronze	545-555	concrete (1: 2 : 4)	146
Cadmium	540	" (1: 1 1/2 : 3)	139
caesium	117	concrete (1: 3: 6)	156
calcium	98.6	copper, pure	554

* At 0° Cent. and atmospheric pressure.

WEIGHTS OF MATERIALS

Material	Lbs. per cu. ft	Material	Lbs. per cu. ft
copper, cast	549-558	Ice	55-57
" wrought	552-558	iodine	300
" wire	555-558	iridium	1399
cork	15.6	iron, pure	491
		" gray cast	439-445
Erbium	297	" white cast	473-482
emery	250	" wrought	487-492
		" steel	474-494
Feldspar	158-162	ivory	114
flint	162		
fluorine*	0.0920	Lead	710
		leather, dry	54
Germanium	341	" greased	64
german silver	515-535	lime, hydrated	30-40
glass, common	150-175	limestone	156-162
" flint	180-280	lithium	39
glucinum	122	loam	65-88
glycerine	78.6		
gold	1203	Magnesium	107
granite	125-187	" carbonate	150
gravel	80-147	manganese	462
gum arabic	90	marble	157-177
gun metal	533	masonry	100-165
gutta percha	61	mercury*	849
gypsum	144	mica	165-200
Hydrogen*	0.00562	molybdenum	529
		mortar, hard	103

* At 0° Cent. and atmospheric pressure.

WEIGHTS OF MATERIALS

Material	Lbs. per cu. ft	Material	Lbs. per cu. ft
muck	40-74	porcelain	143-156
mud	80-130	potassium	53.7
		pumice stone	23-56
Naptha	53		
nickel	540-550	Quartz	165
nitrogen*	0.0782	Resin	67
nitrous oxide*	0.0838	rhodium	773
		rubber, pure	58.0-60.5
Oil, cotton-seed	60.2	" compound	106-124
" lard	57.4	" ebonite	74.9-78.0
" linseed	58.8	rubidium	955
" lubricating	56.2-57.7	ruthenium	767
" petroleum	54.8		
" transformer	52.6-54.2	Salt	129-131
" turpentine	54.2	sand, dry	95-105
" whale	57.3	sandstone	124-200
osmium	1400	selenium	300
oxygen*	0.0895	shale	162
		silicon	131
Palladium	711	silver	660
paper	44-72	slate	162-205
paraffin	54-57	snow, fresh fallen	5-12
peat	20-30	" wet compact	15-50
phosphorus	146	soapstone	162-175
pitch	67	sodium	60.5
plaster of Paris	144	spermaceti	59
platinum	1336	steel	474-494

* At 0° Cent. and atmospheric pressure.

WEIGHTS OF MATERIALS

Material	Lbs. per cu. ft	Material	Lbs. per cu. ft
strontium	158	wood, butternut	24-28
sulphur	120-130	" cedar	37-38
		" cherry	43-56
Talc	168	" chestnut	38-40
tantalum	1040	" cypress	32-37
tar	62.4	" ebony	69-83
tellurium	389	" elm	35-36
thallium	739	" fir	34-35
thorium	686	" hemlock	25-29
tile	113	" hickory	53-58
" hollow	26-45	" lig. vitae	78-83
tin	455	" mahogany	32-53
titanium	218	" maple	49-50
trap rock	187-190	" oak	37-56
tungsten	1174	" pine	24-45
turf	20-30	" poplar	24-27
		" red wood	30-32
Uranium	1165	" spruce	25-32
		" walnut	38-45
Vanadium	343	plywood	34
Water, max. dens.	62.4	Xenon*	0.284
" sea	64.0-64.3		
wax, bees	60.5	Zinc	448
wood, ash	45-47	zirconium	258
" bamboo	22-25		
" beech	43-56		
" birch	32-48		

* At 0° Cent. and atmospheric pressure.

ENGINEERING FORMULAS and CONSTANTS

1 HP = 33,000 Foot-pounds of work per minute.

1 HP = .746 K.W. = K.W. ÷ 1.341.

1 HP = 2547 B.T.U. per hour.

1 B.T.U. = Hear required to raise 1 lb. water 1° F.

1 B.T.U. = 777.6 Foot-pounds work.

1 Kilowatt Hour = 3415 B.T.U.

Heat Value of Carbon = 14,600 B.T.U. per pound.

Latent Heat of Fusion of Ice = 143.15 B.T.U. per pound.

Latent Heat of Evaporation of Water at 212°F. = 970.4 B.T.U. per pound

Total Heat of Saturated Steam at atmospheric pressure = 1,150.4 B.T.U. per pound.

1 Ton of Refrigeration = 288,000 B.T.U. per 24 hours.

g = Acceleration of Gravity (commonly taken as 32.16 feet per second per second).

1 Radian = 57.296 degrees.

1 Meter = 100 cm. = 39.37 inches.

1 Kilometer = .62137 miles.

1 Gallon = 231 cubic inches.

1 Barrel = 31.5 gallons.

Atmospheric Pressure = 14.7 pounds per sq. in. = 29.92 inches mercury at 32° F.

1 Lb. per Sq. In. Pressure = 2.3095 feet fresh water at 62°F. = 2.0355 inches mercury at 32°F. = 2.0416 inches mercury at 62° F.

Water Pressure (pounds per sq. in.) = .433 x height of water in feet (Fresh water at 62°F.).

Weight of 1 cu. ft. Fresh Water = 62.355 lbs at 62°F. = 59.76 lbs. at 212 °F.

Weight of 1 cu. ft. Air at 14.7 lbs. per sq. in. Pressure = .07608 lbs. at 62°F. = .08073 lbs. at 32°F.

OLD BRITISH WEIGHT STANDARDS

16 Ozs. = 1 Lb

14 Lbs. = 1 Stone

8 Stone = 1 Cwt. = 112 Lbs.

20 Cwt. = 1 Ton = 2240 Lbs.

Electrochemistry in a Deep Anode System

Electrochemistry

The most common electrochemical reactions occurring within an impressed current deep anode system involve either metal consumption or gas evolution.

The generalized metal consumption reaction is

$$M \rightarrow M^{+n} + ne^-$$

The metal ion reacts with water in neutral environments to form a metallic hydroxide.

$$M^{+n} + nH_2O \rightarrow M(OH)_n + nH^+$$

Where the evolution of oxygen is the primary reaction, water is consumed.

$$2H_2O \rightarrow O_2 \uparrow + 4H^+ + 4e^-$$

When the sulfate ion is present, a two-stage reaction producing sulfuric acid occurs. However, the complete reaction is the same as reaction since the sulfate ion is recovered.

$$2SO_4^{-2} + 2H_2O \rightarrow O_2 \uparrow + 4H^+ + 4e^- + 2SO_4^{-2}$$

If the chloride ion is present in the ground water, the evolution of chlorine gas is likely.

$$2Cl^- \rightarrow Cl_2 \uparrow + 2e^-$$

The chlorine produced will further react with water producing hydrochloric and hypochlorous acids

$$Cl_2 + H_2O \rightarrow HCl + HOCl$$

Finally, when carbon backfill is used carbon monoxide and/or carbon dioxide are produced.

$$C + H_2O \rightarrow CO \uparrow + 2H^+ + 2e^-$$

$$C + 2H_2O \rightarrow CO_2 \uparrow + 4H^+ + 4e^-$$

As indicated by the above chemical reactions, all of the possible reactions lower the pH of the system. Also, with the exception of the metal oxidation reaction, all of the possible reactions result in the generation of a gas. Finally, note that water is consumed in the oxygen, carbon monoxide, and carbon dioxide evolution reactions.

Practical Galvanic Series

Metal	Volts[1]
Commercially pure magnesium	-1.75
Magnesium alloy (6% Al, 3% Zn, 0.15% Mn)	-1.6
Zinc	-1.1
Aluminum Alloy (5% zinc)	-1.05
Commercially pure aluminum	-0.8
Mild steel (clean shiny	-0.5 to -0.8
Mild steel (rusted)	-0.2 to -0.5
Cast iron (not graphitized)	-0.5
Lead	-0.5
Mild steel in concrete	-0.2
Copper, brass, bronze	-0.2
High silicon cast iron	-0.2
Mill scale on steel	-0.2
Carbon, graphite, coke	+0.3

[1] Typical potential normally observed in neutral soils and , water, measured with respect to copper sulfate reference electrodes.

Control of Pipeline Corrosion, by A.W. Peabody

Standard Wire Size Comparison

Equivalent Cross Sectional Area	Standard Metric Sizes		Standard AWG	Standard Imperial Sizes		Approximate DC Voltage Drop
MM^2	Size MM^2	Strands	Sizes	Size In.	Strands	MV/AMP/Foot * 30°C Ambient
2.5	2.5	1/1.78	–	–	–	2.6
3.0	3.0	–	–	.0045	7/.029	2.2
3.31	–	–	12	–	–	1.7
4.0	4.0	7/0.85	–	–	–	1.7
4.5	–	–	–	.007	7/.036	1.5
5.26	–	–	10	–	–	1.1
6.0	6.0	7/1.04	–	–	–	1.1
6.76	–	–	–	.01	7/.044	1.0
8.37	–	–	8	–	–	.66
9.5	–	–	–	.0145	7/.052	.64
10.0	10.0	7/1.35	–	–	–	.63
13.3	–	–	6	–	–	.43
15.0	–	–	–	.0225	7/.064	.41
16.0	16.0	7/1.70	–	–	–	.40
20.0	–	–	–	.03	19/.044	.33
21.1	–	–	4	–	–	.27
25.0	25.0	19/1.35	–	.04	19/.052	.26
33.6	–	–	2	–	–	.17
35.0	35.0	19/1.53	–	–	–	.17
40.0	–	–	–	.06	19/.064	.16
50.0	50.0	19/1.78	–	–	–	.14
53.5	–	–	1/0	–	–	.11
65.0	–	–	–	0.10	19/.083	.10
70.0	70.0	19/2.14	–	–	–	.10
95.0	95.0	19/2.52	–	–	–	.07
100.0	–	–	–	0.15	37/.072	.06
107.0	–	–	4/0	–	–	.05
120.0	120.0	37/2.03	–	–	–	.05
130.0	–	–	–	0.20	37/.083	.05
150.0	150.0	37/2.25	–	–	–	.04

*Note: For Every 10 °C Increase In Ambient Temperature
Voltage Drop Will Increase Approximately 4%

Electrical Insulators

Material	RESISTIVITY (ρ), MEGOHM-CM	DIELECTRIC CONSTANT (K)
ALCOHOL ETHYL	0.3	5.0-54.6
ALCOHOL METHYL	0.14	31.2-35.0
AMBER	$5X10^{10}$	———
AMYLACETATE	———	4.81
ASBESTOS PAPER	$1.6X10^{5}$	2.7
ASPHALT	———	2.7
BAKELITE	$10^{5}X10^{10}$	4.5-5.5
BEESWAX	$6X10^{8}$	———
CELLOPHANE	———	8
CELLULOID	$2X10^{4}$	13.3
CELLULOSE ACETATE	———	5
GLASS	$5X10^{5}$-10^{10}	5.5-9.1
GLYCERINE	———	56.2
GUTTA PERCHA	$3X10^{4}$	2.9
ICE	720	86
IVORY	200	———
MARBLE	10^{3}-10^{5}	8.3
MICA	$4X10^{7}$-$2X10^{11}$	5-7
OIL, OLIVE	$5X10^{5}$	3.11
" PARAFFIN	10^{10}	———
" PETROLEUM	$2X10^{10}$	2.13
PAPER	10^{4}-10^{9}	1.7-3.8
PARAFFIN	$5x10^{10}$-$5x10^{12}$	1.9-2.3
PORCELAIN	$3x10^{8}$	4.4
QUARTZ	10^{8}-$5x10^{12}$	4.7-5.1
ROSIN	$7x10^{9}$-$5x10^{10}$	2.5

Electrical Insulators (continued)

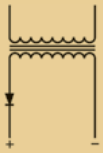
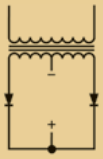
MATERIAL	RESISTIVITY (ρ), MEGOHM-CM	DIELECTRIC CONSTANT (K)
RUBBER, HARD	$3x10^{10}$-10^{12}	2.0-3.5
SEALING WAX	10^{9}-$8x10^{9}$	———
SELENIUM	0.06	6.1-7.4
SHELLAC	10^{10}	3.0-3.7
SILICA, FUSED	10^{8}-10^{13}	3.5-3.6
SLATE	10^{2}-10^{4}	6.6-7.4
SULPHUR	$8x10^{9}$-10^{11}	2.9-3.2
TURPENTINE	———	2.23
WATER, DIST	0.5	81
WOOD, PARAFFINED	$3x10^{4}$-$4x10^{7}$	4.1

Electrical Conductors

MATERIAL	RESISTIVITY (ρ), MICROHM-CM	TEMPERATURE COEFFICIENT (∝) OF RESISTANCE
ALUMINUM	2.688	0.00403
ANTIMONY	39.1 @ 0	0.0036
BARIUM	9.8	0.0033
BERYLLIUM	10.1	———
BISMUTH	120	0.004
CARBON	3500 @ 0	-0.0009
CALCIUM	4.59	0.00364 (0-600)
CERIUM	78	———
CESIUM	19 @ 0	———
CHROMIUM	2.6 @ 0	———
COBALT	9.7	0.00658 (0-100)
COPPER	1.724	0.00393

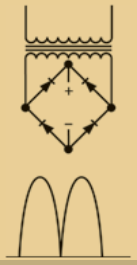
MATERIAL	RESISTIVITY (ρ), MICROHM-CM OF RESISTANCE	TEMPERATURE COEFFICIENT (∝)
GOLD	2.44	0.0034
GRAPHITE	800 @ 0	———
IRON	9.8	0.0065 (0-100)
CAST IRON	79-104	———
LEAD	22.0	0.0039
LITHIUM	8.55 @ 0	0.0047 @ 0
MAGNESIUM	4.46	0.0040
MANGANESE	5	———
MERCURY	95.8	0.00089
MOLYBDENUM	5.08 @ 0	0.0047 (0-100)
METAL MONEL	42	———
NICKEL	7.8	0.00537 (20-100)
OSMUIM	9.5	0.0033
PALLADIUM	11	———
PLATINUM	9.83 @ 0	0.003
POTASSIUM	6.1 @ 0	0.0055 @ 0
RHODIUM	5.11 @ 0	0.0043 @ 0
SILVER	1.629 @ 18	0.0038
SODIUM	4.3 @ 0	0.0054
STRONTIUM	24.8	———
TANTALUM	15.5	0.0031
TELLURIUM	$2X10^5$	———
THALLIUM	17.6 @ 0	0.0040 @ 0
THORIUM	18	0.0021 (20-1800)
TIN	11.5	0.0042
TITANIUM	3.0	———
TUNGSTEN	5.5	0.0047 (0-100)
ZINC	5.75 @ 0	0.0037

CHARACTERISTICS

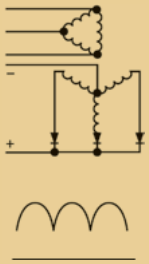
TYPE OF CIRCUIT		SINGLE PHASE HALF WAVE	SINGLE PHASE CENTER-TAP
PRIMARY SECONDARY			
ONE CYCLE WAVE OF RECTIFIER OUTPUT VOLTAGE (NO OVERLAP)			
NUMBER OF RECTIFIER ELEMENTS		**1**	**2**
AVERAGE D.C. VOLTS OUTPUT	=	1.00	1.00
RMS D.C. VOLTS OUTPUT	=	1.57	1.11
PEAK D.C. VOLTS OUTPUT	=	3.14	1.57
PEAK REVERSE VOLTS	=	3.14	3.14
PER RECTIFIER ELEMENT	=	1.41	2.82
	=	1.41	1.41
AVERAGE D.C. OUTPUT CURRENT	=	1.00	1.00
AVERAGE D.C. OUTPUT CURRENT PER RECTIFIER ELEMENT	=	1.00	0.500
RMS CURRENT PER RECTIFIER ELEMENT			
RESISTIVE LOAD	=	1.57	0.785
INDUCTIVE LOAD	=	---	0.707
PEAK CURRENT PER RECTIFIER ELEMENT			
RESISTIVE LOAD	=	3.14	1.57
INDUCTIVE LOAD	=	---	1.00
RATIO:			
PEAK TO AVERAGE CURRENT PER ELEMENT			
RESISTIVE LOAD	=	3.14	3.14
INDUCTIVE LOAD	=	---	2.00
% RIPPLE $\left(\frac{\text{RMS OF RIPPLE}}{\text{AVERAGE OUTPUT VOLTAGE}}\right)$	=	121%	48%
	=	**RESISTIVE LOAD**	
TRANSFORMER SECONDARY RMS VOLTS PER LEG	=	2.22	1.11 (TO CENTER-TAP)
TRANSFORMER SECONDARY RMS VOLTS LINE-TO-LINE	=	2.22	2.22
SECONDARY LINE CURRENT	=	1.57	0.707
TRANSFORMER SECONDARY VOLT-AMPERES PER LEG	=	3.49	1.57
TRANSFORMER PRIMARY RMS AMPERES PER LEG	=	1.57	1.00
TRANSFORMER PRIMARY VOLT-AMPERES PER LEG	=	3.49	1.11
AVERAGE OF PRIMARY AND SECONDARY VOLT-AMPERES	=	3.49	1.34
PRIMARY LINE CURRENT	=	1.57	1.00
LINE POWER FACTOR	=	---	0.900

OF CIRCUITS

SINGLE PHASE BRIDGE



THREE PHASE STAR (WYE)



*Assumes zero forward drop and zero reverse current in rectifiers and no AC line or source reactance.

TO DETERMINE ACTUAL VALUE OF PARAMETER IN FIRST COLUMN, MULTIPLY FACTOR SHOWN BY VALUE OF:

4	3		
1.00	1.00	X	AVERAGE D.C. VOLTAGE OUTPUT
1.11	1.02	X	AVERAGE D.C. VOLTAGE OUTPUT
1.57	1.21	X	AVERAGE D.C. VOLTAGE OUTPUT
1.57	2.09	X	AVERAGE D.C. VOLTAGE OUTPUT
1.41	2.45	X	RMS SECONDARY VOLTS PER TRANSFORMER LEG
1.41	1.41	X	RMS SECONDARY VOLTS LINE-TO-LINE
1.00	1.00	X	AVERAGE D.C. OUTPUT CURRENT
0.500	0.333	X	AVERAGE D.C. OUTPUT CURRENT
0.785	0.587	X	AVERAGE D.C. OUTPUT CURRENT
0.707	0.578	X	AVERAGE D.C. OUTPUT CURRENT
1.57	1.21	X	AVERAGE D.C. OUTPUT CURRENT
1.00	1.00	X	AVERAGE D.C. OUTPUT CURRENT
3.14	3.63		
2.00	3.00		
48%	18.3%		

INDUCTIVE LOAD

1.11 (TOTAL)	0.855 (TO NEUTRAL)	X	AVERAGE D.C. VOLTAGE OUTPUT
1.11	1.48	X	AVERAGE D.C. VOLTAGE OUTPUT
1.00	0.578	X	AVERAGE D.C. OUTPUT CURRENT
1.11	1.48	X	D.C. WATTS OUTPUT
1.00	0.471	X	AVERAGE D.C. OUTPUT CURRENT
1.11	1.21	X	D.C. WATTS OUTPUT
1.11	1.35	X	D.C. WATTS OUTPUT
1.00	0.817	X	AVE. LOAD CURRENT X SEC. LEG VOLT. / PRI. LINE VOLT.
0.900	0.826		

Disclaimer

Disclaimer: Loresco International has made every effort to ensure that the data contained within the Reference Data section is correct and complete. However, neither Loresco International nor any of its employees warrants or accepts any liability for the information contained therein.

Loresco® products are produced in Hattiesburg, Mississippi on an eight acre plant site. The plant's facilities are modern with all production performed on controlled areas to assure quality.

The facility has over 300 meters of dedicated heavy rail which assures production can supercede all requirements. The facilities screening, blending, grinding, and packing abilities are dedicated to quality control and service. Most orders are shipped within twenty-four hours with no charges for same day service.

Loresco® International is dedicated to the corrosion industry. Our only business is to serve the corrosion industry. We are dedicated to producing the highest quality impressed current anode backfill in the world. Our products serve the corrosion industry by setting the performance standard for impressed backfill.

Loresco® works.

LORESCO®

875 Old Richburg Rd
Purvis, MS 39475
www.loresco.com

Ph: 601-544-7490
Fax: 601-544-7531
Email: info@loresco.com

Version: March-05-2023